

July 24, 1961

Aviation Week and Space Technology

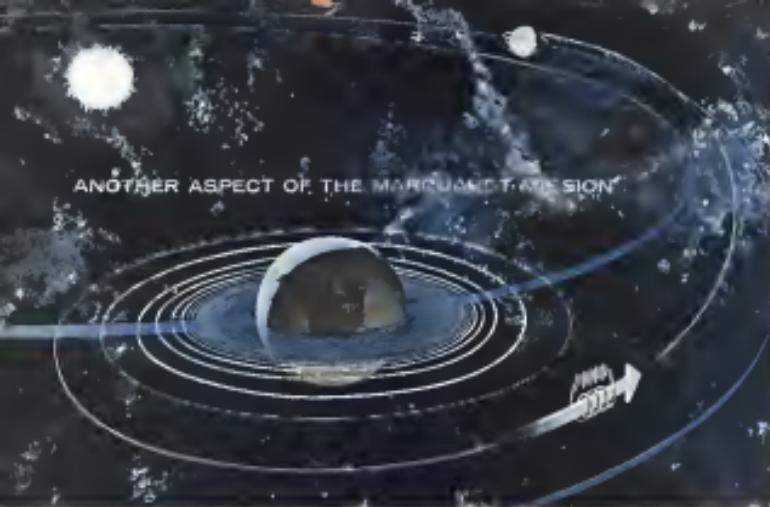
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Of New Russian
Military Aircraft

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Soviet Yakovlev Blinder
Interceptor-Bomber





ANOTHER ASPECT OF THE MARQUARDT MISSION

ELECTRIC PROPULSION

Retarded space travel, free from gravitation in a natural vacuum, presents new and difficult problems in the propulsion and control of space vehicles. Electric propulsion promises a potential and economical means of accomplishing space exploration programs.

The three main types of electric engines, while varying in performance specifications, share common advantages over chemical engines. The electrothermal, electrodynamic, and electrostatic engines offer specific impulses greater than 1,000 seconds and thrust durations measured in weeks to months. As a result electric propulsion systems have the capacity to deliver much larger payloads over longer distances than will conventional rockets. Power for these electric engines can be drawn either from nuclear energy sources built into the vehicle or from solar collectors.

The Marquardt Corporation—long a leader in the field of propulsion—is intensively engaged in a variety of unique electric propulsion projects. An example in the electro-thermal area is the Boreasjet, here the hydrogen propellant passes over an electrically heated resistance element prior to



THE
Marquardt
CORPORATION
CORPORATE OFFICES, VAN NUYS, CALIFORNIA

CAPABILITY is spelled

s-e-r-v-i-c-e

Aerospace components—even those with the highest order of reliability—must be backed by an organization capable of providing all the requirements of a complete service program.



At Eastern Air Lines Maintenance Howard Crothers of Vickers checks installation of DC E-Pump at service test cell with L. Nacholt, Foreman, and J. Schaefer, lead mechanic.

Proposed modification of struts for improved service and reduced maintenance is discussed with EAM, engineers Minly and Young.

Fast service to customers on overhauled units is ensured by large stocks of retiming group availability.



Proper overhaul and parts inspection inspections are observed by A. Weigold, general foreman of assembly overhauled for Eastern Air Lines.

VICKERS offers the skills, experience and/or material for all areas of aircraft service areas: 1. field service, 2. product improvement, 3. technical publications, 4. spare parts, 5. repair and overhaul, 6. training for customers and Vickers personnel, and 7. product support tools and test equipment.

Availability of skills and services in depth is the heart of the Vickers program. For example—technical representatives not only provide the unmatched skills and experience needed to assist reliability and aviation maintenance personnel but also gather performance and statistical information for improvement in existing products or for new designs.

Highly skilled, broadly experienced technical representatives like Howard Crothers, a 19-year Vickers service veteran, are available wherever needed throughout the free world. Equally important, they can draw on the talents of a large, experienced organization when specialized skills are needed. More details on the many facets of Vickers service are available in Bullets 6000-A and A-5229. Write, wire or call today for your copies.



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POWER TRANSMISSION • ENERGY CONVERSION

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Here's Why **Silastic** Is Used In Man's Probes Into Space!

By going faster and farther into space, the X-15 adds to our rapidly expanding knowledge about the changes of man and materials occurring by day and night—and back. That's why only proven materials are selected. One of those is Silastic® LS, the Dure Casting fluorocarbon rubber that resists oils, fuels and solvents.

Engineers of Reaction Motors Division of Thiokol Chemical Corporation specified an autocatalytic diaphragm of Silastic LS for the X-15's XLR-99 engine. The autocatalytic process of N_2 at constant pressure to the tube of pump. Gaseous nitrogen under pressure is the source of stored energy, and is separated from the XLR-99 Homogeneous jet by the Silastic LS.

Here are displacement requirements the designers utilised as essential for maximum flexibility from -40 to 200°F (Solvite LB minimises its flexibility from -40 to 300°F); compatible with the life of oil at low and elevated temperatures (Solvite LB has little swell or change in viscosity after saturation in many hot oils, fuels and some hydrocarbons fluids); will not contaminate base oil (Solvite LB has no particulate or additive which can contaminate by leaching).



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Aviation Industry Handbook.

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MIDLAND, MICHIGAN

AVIATION CALENDAR

Aug 13-15—South Western Raymond Meeting of American Astronautical Society
Metropolitan Hotel, San Francisco, Calif.
Aug 13-15—10th Annual U. S. National Conference on Space Research
Aug 24-26—Meeting of American Astronautical Society
Applications for 16th Annual Florida Meeting of American Astronautic Society
Metropolitan Hotel, St. Petersburg, Fla.
Aug 3-6—North Central Stand-Up Airplane Managers Conference, Miami Beach, Fla.
Aug 7-9—Gathering and Navigation Conference American Rocket Society
Metropolitan Hotel, St. Petersburg, Fla.
Aug 15-17—Orbital Engineering Conference
University of Michigan, Ann Arbor, Mich.
Aug 16—International Heterogeneous Conference American Rocket Society
Metropolitan Hotel, St. Petersburg, Fla.
Aug 19-25—Institute of the Aerospace Sciences
"Space and Aviation Meeting," New York City
Aug 22-25—Winter Electronic Show
C. C. P. Convention Hall, San Francisco, Calif.
Aug 27-29—18th Biannual Gas Dynamics and Heat Transfer Symposium American Rocket Society
Northeastern Technological Institute
Brooklyn, N. Y.
Sept 4-6—North American Regional Meeting
Glen Echo Club of America, Atlanta, Ga.
Worlton, Ga.
Aug 25-30—West Coast Conference of Applied Mathematics, University of Southern California
Los Angeles, Calif.
Aug 26-28—International Heat Transfer Conference, Institute of Colorado
Boulder, Colo.

(Continued on page 6)

AVIATION WORK and Safety Training

July 34, 1967
Not. 22, Reg. 4

and the author with an additional layer of the author's name.



TOTAL POWER SOLUTIONS... FROM ITT

THE MOST ADVANCED POWER CONVERSION JOB YET ATTEMPTED.

Show here is a simplified block diagram of the various integrated power conversion system now being designed and manufactured by ITT for the Project Ranger moon probe built for NASA by Jet Propulsion Laboratory. The overall system provides 27 different DC and AC outputs of several discrete voltages, currents and frequencies, ... using ground, solar cell and battery power sources.

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Kodde pressure vessels range from door-knob size to 2500 cubic inches capacity, have a life of 10 cycles to 300,000 cycles; pressures up to 30,000 psi. Kodde pressure vessels are made in steel, fiberglass, aluminum—welded or drawn—titanium—welded—minimum weight for application. Configurations are practically limitless—excluding cylindrical, spherical, conical, torus. Many are available on an off-the-shelf basis.

In addition to solving current problems in pressure vessel applications, Kiddie engineers are also hard at work advancing today's technology to solve tomorrow's problems. So, if pressure vessels have you stumped, why not call on Kiddie for the answer—most people do.



Kidde Aero-Space Division

Walker Kuhle & Company, Inc., 111 Main St., Belleville 8, New Jersey

Cost-Effectiveness of Adalimumab vs Infliximab for Treating Moderate to Severe Crohn's Disease. *J Clin Gastroenterol* 2013; 47(10): 743-749.

AVIATION CALENDAR

(Continued from page 51)

Aug. 16-Sept. 1—Second Annual Radio-Symposium General Electric Advanced Electronics Center, Coastal Division, Detroit, Mich.

Aug. 16-Sept. 1—Third Annual Seminars on Conference, American Institute of Mining, Metallurgical and Petroleum Engineers, Ambassador Hotel, Los Angeles, Calif.

Sept. 4-10—1961 Flying Displays and Exhibits Program, 1961 Annual Convention, Transport Club, London, England.

Sept. 4-14—Eightieth Annual Convention Conference, Royal Aeronautical Society and Institute of the Aeronautical Sciences, London, England, Willesden Green, London, Sept. 12.

Sept. 4-14—National Conference on Space Electronics and Telemetry, Institute of Radio Engineers, University of New Mexico, Albuquerque, N. M.

Sept. 7-8—All Meeting, Western States Telecommunications Association, Inn of the Century, Culver City, Calif.

Sept. 10-11—National Convention, National Automobile Air Weather, New York City.

Sept. 13-14—International Operations and Maintenance Symposium, Aircraft Corp., Quonset, R. I.

Sept. 13-14—Annual Meeting, Armed Forces Communications Association, Statler Hilton Hotel, Washington, D. C.

Sept. 13-17—Ninth Annual Joint Services Engineering Conference in Institute of Radio Engineers, Hotel Rome, New York, N. Y.

Sept. 17-19—National Convention, National Assn. of State Agency Officials, Miami Beach, Fla.

Sept. 26-28—Industrial Electronics Show, Phoenix, Institute of Radio Engineers, Phoenix, Ariz.

Sept. 29-24—National Convention and Airshow, Farnborough, Air Force Assn., Philadelphia, Pa.

Sept. 26-28—Annual Convention, National Broadcasters Assn., Hotel Statler, Hotel New Yorker, New York City.

Sept. 28-30—Sixth International Symposium on Photo-Fatigue and Symposium (including a Session on the Inspection, Inspection and Analysis Programs), Beverly Hills Hotel, Beverly Hills, Calif.

Sept. 29-Oct. 3—National Communications Symposium, Institute of Radio Engineers, Hotel Union, White Plains, N. Y.

Oct. 2-7—12th International Astronautical Congress, Washington, D. C.

Oct. 3-4—National Airport Conference, University of Oklahoma, Norman, Okla.

Oct. 4-6—National Aerospace Engineering & Manufacturing Meeting, Society of Automotive Engineers, Ambassador Hotel, Los Angeles, Calif.

Oct. 9-13—Annual Rocket Society's 10th Annual Meeting & Space Flight Conference, Hotel New Yorker, New York City.

Oct. 14-21—Federation Astronautique Internationale 1961 General Conference, Hotel de Quatre-Bras, Rio de Janeiro, Brazil.

Oct. 20-24—First Meeting, Council on Aviation Research, Institute of the Aerospace Sciences, New York City.

Oct. 21-25—7th Annual Meeting, International Air Transport Assn., Hotel New Yorker, New York City.

SEGMENTED
Solid Rockets for Space

Aerospace-Battelle's segmentation principle promises reliable off-the-shelf boosters for space missions. Standardized, interoperable segments are stacked and clustered to produce any desired thrust — tailoring the power of the solid motor to meet the requirements of the revised

Segregation is a proven principle. After several successful uncrewed flights beginning as early as February, 1960, a maned rocket successfully test flight was the first flight of a 90-ton giant probe bearing a half million pounds of thrust. This motor was made of three segments joined together just before lifting.

Ariane's augmented solid rockets provide a rapid, economical response to the challenge of placing large payloads in space.

SOLID ROCKET PLANT

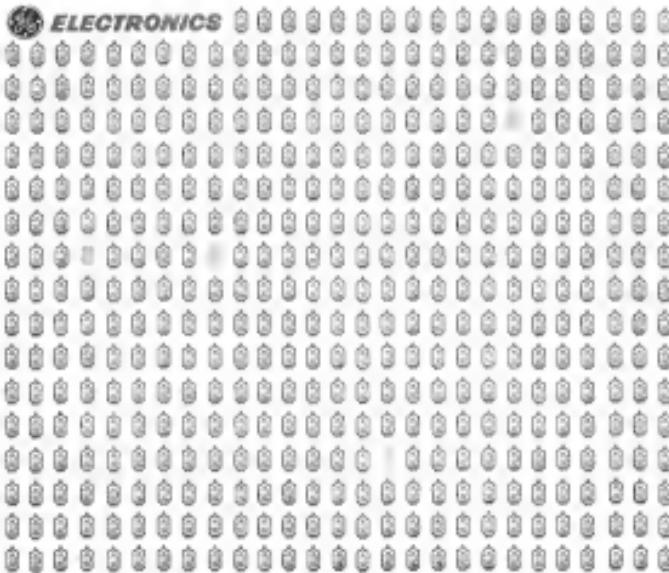
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Fractures, dislocations – problems related to pronunciation of the root



ELECTRONICS



G-E Five-Star tubes prove 99.11% reliable in 10,000 hour life test

Four hundred and fifty type 5559 Five-Star tubes were subjected to a 100-hour test to study the effects of heater voltage, anode-cathode potential and plate dissipation on vacuum tube life and reliability. After 10,000 hours of operation, failure rates were such that statistical significance could be attached to them. Of the 450 tubes tested, only four failures occurred: two at 2800 hours, one at 3386 hours, one at 9000 hours—despite the fact that the test parameters were purposely made severe enough to produce early failures. For example, in test lot number six, 36 type 5559 Five-Star tubes were tested

under severe conditions (elevated heater voltage, 6.5 volts, over 100 watts negative heater-cathode potential, 3.88 watts per plate dissipation). There were no failures at 19,000 hours. The data supplied upon request.

In life tests such as this, and in everyday performance, G-E Five-Star tubes prove their reliability in critical applications: airborne navigation and communications, industrial controls, television equipment, broadcast. Five-Stars are not hard to find, from standard retailing outlets. They are specially designed, specially manufactured to cope with particular electrical requirements

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The LA-500 Series is the smallest non-pendulum linear accelerometer available today featuring a variable reluctance pickup and essentially constant damping over the temperature range of -30° F to +120° F. It is the smallest instrument of its type that can measure acceleration forces up to 60 G.

Reliability through overall simplicity was the primary goal of the LA-500 design. An example is the telemeter report which eliminates sleeve bearings and their inherent friction. The result of this basic design objective is an accelerometer which can be relied upon

to operate instantaneously and for long periods, even after months of storage.

The combination of miniaturization, ruggedness, and high performance makes this instrument ideally suited for advanced aircraft and missile applications where space and weight considerations are critical.

Write for Technical Bulletin BM-SLA5-2 to Minneapolis-Honeywell, Boxes Division, Dept. 2, 1460 Soldiers Field Road, Boston 36, Mass., or call your local Military Products Group Office. Sales and Service offices in all principal cities of the world.



Subminiature
accelerometer
allows 100

PERFORMANCE DATA

- SIZE: 1 inch in diameter by less than 1/8 inch in total height
- WEIGHT: 1.5 oz. (including 2 sensors)
- Damping Ratio: 0.95 constant -30° F to +120° F
- Frequency: Up to 100 c
- FEATURES: Non-pendulum, reluctance design minimizes inertia, maximizes damping and high signal-to-noise ratio
- Low Threshold: Excellent resolution
- Linearity: ±1% to full scale
- Excellent Linearity: ±0.05% to full scale
- Low Hysteresis: Less than 0.05% full scale
- Linear Variation: 15.0 G's to be for 0 G's up to 30.0 G's to be for 6 G's
- Linear Variation: 15.0 G's to be for 0 G's up to 30.0 G's to be for 6 G's

Custom designed for your specific linear accelerometer requirements.

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New 10-place jet trainer

The Lockheed C-140 is a compact jet transport. It flies fast and high like jet fighters and interceptors — at just a fraction of their operating and maintenance cost. It can train an entire class of students for hours at a time, rather than one man for a few minutes. And students learn the fine art of operating radar and weapon control systems in tactical and strategic aircraft in a favorable environment, because the C-140's entire cabin is pressurized and air-conditioned. Students see the real thing on their radarscopes and instruments. The Lockheed C-140 also can stretch defense dollars when used for navigational aids checking, casualty evacuation, aerospace system flight testing, and for high priority cargo and passengers.

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Lockheed Aircraft Corporation, Georgia Division, Marietta, Georgia.



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Each Superpak contains one sheet of Anso Superpak[®] 'A' or 'B' X-ray film. (Both yield excellent definition.) The only difference is in speed for dry or fast prints. Superpak tapes directly to the aircraft surface, conforming to the contours of skin, airflow and structural members. No deckroom loading ... no holders ... no scratches, dirt or dust. Complicated in-

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Forming and machining the ultra-tough materials needed in missile manufacture requires muscle...well-developed power and brawn...to precisely bend and shape and expand and forth parts which ultimately become stronger than the machines that produced them. In this respect we feel that the Lionel organization is especially capable. For materials which resist conventional forming methods, we've built our own muscles...our own machines and equipment, our own tools, devices, and techniques...all capable of processing elongate alloys to fine tolerances at high speeds on a routine production basis. Lionel-designed machines such as the "IMPRES" (Internal Mandrel Pressure Bell Extrusion Shaper) provide high-speed hydroforming of nose cones with superior dimensional accuracy. In its entirety, The Lionel Corporation presents a vast capabilities complex, each division highly experienced in the design, development, and construction of advanced high quality hardware. Our engineers, physicists and chemists, equipped with modern, efficient laboratory and production facilities, afford a logical and worthy source for the dependable fulfillment of contracted commitments—from components through systems.

We welcome your further inquiry...and suggest that you request a copy of our new capabilities brochure, "LIONEL—A New Force."



THE LIONEL CORPORATION Dept. 37-AV, Hoffmann Place, Hillsdale, N. J.



Command Reliability

New Sperry SP-50 Flight Control System

An automatic flight control system offering 200 to 300 percent increase in reliability—with unexcelled accuracy and performance—that's the new Sperry SP-50, selected over heavy competition for the forthcoming Boeing 727.

Selection of the SP-50 for the short-to-medium range T2P-a jet transport which demands the ultimate in reliability for everyday operations in and out of small airports—emphasizes the fact that the SP-50 solves the most pressing problems of aircraft-navigation systems. It is compatible with the early automatic landing systems of the future, it is designed for routine ILS operations with automatic holdovers for landings under very low ceiling-visibility conditions, it features超smooth designs, separating automatic control equipment for all axes of flight to facilitate maintenance, and it provides dual yaw dampers, with provision for "dualizing" all functions if desired.

These and other design and performance advantages in the new SP-50 spell superior commercial reliability today...insure readiness to meet tomorrow's demands. Superior support of this new system in the field, meeting Air Transport Association requirements, also is being "finalized in" by Sperry.

SPERRY

SPERRY PHOENIX COMPANY, DIVISION OF SPERRY RAND CORPORATION, PHOENIX, ARIZONA

population - 0



Even in the most remote areas, wings aloft are guided on their way by Aerocom's new medium range N.D. Beacon Transmitter. This transmitter was designed and built to provide long, trouble-free service with no attendant...even where the total population is zero.

NOW — FCC type accepted — single or dual automatic — for carrier powers of 16, 12, 15, 20, 25, 50 and 100 watts.



AEROCOM'S Dual Automatic Package-Type Radio Beacons

For completely unattended service, The N.D. Beacon [illustrated] consists of two 100 watt (or 50 watt) transmitters with 2 layers, automatic transfer and system timer. Power needed 110 or 220 volt 50/60 cycles, 650 V.A. for 50 watt, 652 V.A. for 100 watt.

Frequency range 200-500 kc., available with either crystal or self excited oscillator coil. High level plate modulation of dual amplifier is used, giving 97% tone modulation. Macrophone P-T switch interlocks tone generating voice operation.

The "stand-by" transmitter is selected when the carrier or modulation level of main transmitter drops 3 db or more, in case of failure to measure the identification signal or if carrier frequency changes 5 kc. or more. Audible indication in monitoring receiver tells which transmitter is in operation.

Unit is ruggedly constructed and conservatively rated, providing low operating and maintenance costs.

Also available in 400 watt, 1 K.W. and 4 K.W. Models, 200-415 kc.



AER - O - COM 3090 S.W. 37th AVENUE • MIAMI 33, FLORIDA



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mounted on a fiber glass frame beltled to the operator. Offering a promise of increased mobility for tomorrow's soldier, the Bell rocket belt is another in a series of significant achievements from Textron—a group of growing companies with products that lead the way in their fields. ■ Consumer 24% of total sales volume, Defense 22%, Industrial 20%, Textile 17%, Automotive 17%.

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THE NEW ENGINEERING BULLETIN BOOKS YOU WANT IN THE HYDRAULIC PUMP DESIGN YOU MAY BE LOOKING FOR. HERE, PAVING THE WAY, ARE HIGH PERFORMANCE AIR PUMPS MADE TO THE MEASURE OF THE VAST GOVERNMENT AIRCRAFT, MILITARY, AEROSPACE, AND RELATED EQUIPMENT.

Many of these pumps are the products of ready made, mass produced components that can be tailored into the precise configuration you need. Custom designed pumps are also available.

All have in common these classic Eastern hydraulic pump characteristics:

SMALL SIZE Eastern gear pumps are the smallest, lightest, most compact air/oil pumps available. The 1350 pump (2 1/2" dia. x 1 1/2" x 2 1/2", weight 9 lbs.

WIDE PERFORMANCE RANGE Eastern available have flow rates from 0.016 to 1.30 cu. in. per revolution — flow from .035 to 9.6 gpm, pressures from 0 to 2000 psi, at speeds up to 24,000 rpm. Weight with motor range from 1.3 to 8.3 lbs.

UNAFFECTED BY EXTREME ENVIRONMENTS rugged, reliable Eastern units take harsh to 50% in stride — strong off temperature requirements to minus 100° F.

Other Eastern products:

- hydraulic motors
- intercoolers, compressors, receivers and systems
- pressurization/delubrication ports
- quick-disconnect couplings
- electronic tube cooling units

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**revolutionary
new power cutter
from UTICA**


The Utica SA-100 is an air-operated, compact hand power cutter for high volume production. Designed for the electronic industry, the SA-100 cuts hours of assembly time — reduces operator fatigue to a minimum. Snap cuts as fast as the opening lever can be triggered.

This new product of our Utica Drop Forge & Tool Division symbolizes Kelsey-Hayes capabilities in diversified areas of industry. Long experience and broad usage in research, development and practice are employed in contemporary tools that bear the stamp of the future.

For further information on the Utica SA-100 Power Cutter, write: The Utica Hand Tool Division, Kelsey Hayes Company, Utica 4, N.Y.

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This complete capability can help you in designing and producing light, strong, heat-resistant structures for rocket motor cases, nozzles, and pressure vessels. For further details on the filament-winding process, write *B.F. Goodrich Aviation Products, a division of The B.F. Goodrich Company, Dept. AP-7B, Akron, Ohio.*

BEGoodrich aviation products

EDITORIAL

Another Surprise Coming?

The Tashkent air show of a few weeks ago provided a sharp surprise to the American people, who had been misled by their leaders in recent years to believe that the Soviet Union had abandoned advanced development of manned aircraft and was concentrating solely on ballistic missiles and space research. These leaders in turn have been badly informed by their intelligence services, not because of the wording-level report but because of top-level intelligence cannot determine to give an exact date that did not set their preconceived idea of what should be happening.

Although Crisp and Trotman revealed some of the cognitive entrepreneurship in the use of our national intelligence estimating machinery, the full impact of this vainglorious boasting has yet to be told; probably because it is well shielded under the official stamp of secrecy.

However much of a shock it is to the American people to discover that the Red Air Force, which was supposed to be fading into obsolescence, had suddenly blossomed out with a full array of new generation aircraft across the whole technical spectrum from supersonic bombers and long-range interceptors to small transports and helicopters, we wonder if an even greater shock may not be in the offing. We wonder if the all reported ban on nuclear testing that the United States has been operating under for the past three years may not be leading toward the disruption of our own commanding lead in nuclear weapons development. Will we wake up another Moon or morning soon and find that the Soviets have been secretly testing new generation of nuclear weapons that outmatch us publicly with their operational equality?

This pamphlet has also been issued by John McCane, a California Republican who has had a long and distinguished career in government both in the Defense Department and as chairman of the Atomic Energy Commission. This is what he had to say on this point recently:

"Nuclear weapons development by underground and outer space testing will give to either the United States or the Soviets an array of weapons, both large and small, more powerful, more versatile and more useful to mankind, far greater than those now exist. The Soviets can proceed with these developments behind their Iron Curtain without detection, as no present scientific means of detecting their actions can or will be created without inspection posts within their country and the right for on-site inspection."

The Soviet's adamant refusal to accept a reasonable plan for placing a test ban agreement by retaining appropriate means for inspection is reason to believe they are developing new and improved weapons in clandestine testing. That they can develop a great military capability and yet, respecting a self-imposed moratorium, will take second place.

"Efforts to reach agreement have now failed because

of Soviet intransigent positions. Our security is at stake. We must resume weapons testing as essential to the safety of our country and the free world. Soviet negotiations that they are not interested in testing appear indisputable as similar statements were frequently made regarding manned aircraft, but now they display several new flight planes secretly developed.

"Will they soon display advanced nuclear weapons?"

The total impetus toward a nuclear test ban came from the world-wide public concern over nuclear fall-out accidentally passed to the Soviet Union. Admittedly, the stupid errors exposed by the Atomic Energy Commission on the basic basis of fall-out contributed immensely to the success of the Soviet leaders' pronouncements and it another example of how serious harm much more than it can possibly help.

Now, however, the techniques of underground testing have been developed to the point where considerable development work can be done by the method without any atmospheric fall-out. Development of nuclear testing in outer space is certainly feasible, although considerable work on adequate environments must be done before it can possibly help. Here too, atmospheric fall-out is eliminated.

The really important lesson to be learned from the Tashkent air show of 1961 and the field trip to be avoided is containing a unilateral nuclear test ban is that in dealing with the Soviets we must cover all technical possibilities under the board. If we are to avoid the disastrous consequences of strategic surprise, then it is no use, short of national security in dealing with an informed and knowledgeable adversary as the USSR. The Soviet Union is developing every plane of its military power, from the means of land troops to equipped with mobile missiles that can be guided by helicopter or antiaircraft launching vehicles, air-borne tanks and antitank to the supersonic bombers and fighters of the air force, the armed well formidable navies to the ballistic missile rocket forces and finally to the military applications of outer space.

This country can no longer afford to follow the complete premise that our military forces are so inadequate to cope with any situation the Soviets may get into. In all but a few areas our state of military preparedness is extremely low.

If we are to convince either our friends or foes that we mean what we say about Berlin or any of the other crises that are certain to arise along the US-USSR interface, we had better stop talking about how wonderful our "wonder weapons" are and begin to actually do something about plugging the great gaps that exist in our current military power. At the same time, we must continue adequate preparations for the future development of all of the incredibly fantastic possibilities the galloping technologies of our time now reduce to the realm of probability.

—Robert Holt

The SPS 260,000 Series



LW 26
Steel on Steel

PN 26
Copper on Copper



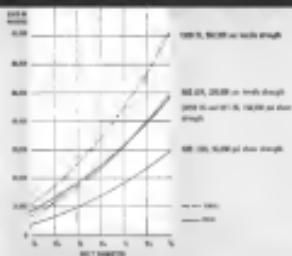
26085 26
Copper on Copper

EW 26
Steel on Steel

SFT 26, SPS 26
Steel on Steel

Ultimate in tensile, ultimate in shear

TENSILE STRENGTH vs. BOLT DIAMETER SHEAR STRENGTH vs. BOLT DIAMETER



The tensile and shear bolts and the locknuts shown here comprise a fastening system at the 260,000 psi strength level—highest yet achieved. Products of SPS research these fasteners were designed to meet the exacting strength need of the aerospace industry. Higher strength fasteners are available.

The LW 26 gives a tensile strength range of 260,000 psi to 290,000 psi, a shear strength range of 260,000 psi to 290,000 psi, and a locknut strength range of 260,000 psi to 290,000 psi. An EWS 26 is a plain or a conventional bolt, 100% as strong as a LW 26, and heavier. And because of the smaller bolt hole required, corresponding single and lighter components and designs may easily be used.

The EW 26 and the SFT 26, which are produced from material heat-treated to a tensile strength of 260,000 psi each, offers a tensile strength of 260,000 psi to 290,000 psi, a shear strength of 260,000 psi to 290,000 psi, and a locknut strength of 260,000 psi to 290,000 psi. An EWS 26 has a strength of 260,000 psi to 290,000 psi, and a locknut strength of 260,000 psi to 290,000 psi. An SFT 26 has a strength of 260,000 psi to 290,000 psi, and a locknut strength of 260,000 psi to 290,000 psi.

The extraordinary strength-to-weight ratios achieved by the SPS 260,000 series fasteners are the result of:

- Continuous grain flow through head and shank
- E-10 R tensile form (MIL-S-8751 revised after test evaluation)
- Cold working of high stress areas
- Cadmium plating by vacuum deposition
- Forged of 100% chrome high-strength alloy steel

EW 26 bolts and components (N 26 locknuts—are available in sizes #10-12 through #14. EWS 26, SFT 26, Copper on Copper, and SFT 26-H (hex locknut) are also available. EWS 26 locknuts are available in sizes #10-12 through #16. AIRFRAMING (WIRE) OVERSIZES 50% STANDARD PRESTO STEEL CO., JOHNSTOWN, PENNSYLVANIA • SANTA ANA, CALIFORNIA.

Ordering for the SPS 260,000 Series
EW 26: Telephone No. 211-188-2110 ED
SFT 26: Telephone No. 211-188-2110 ED
LW 26: Telephone No. 211-188-2110 ED

SPS

ultra-reliability replaces probability

Airframe Co. • Bolted Tech • Std-Bolted, Gage • SPS Locknut Co. • SPS Locknut • Threadlock • Threadlock N.Y. • Nitrolock • Nitrolock

WHO'S WHERE

in the Front Office

W. F. Sculley, executive vice president, and Gary Shultz, president of the board, have joined Los Angeles Defense North America Inc., Los Angeles.

John H. Schatzberg, chairman of the space and defense marketing division, Electronic Components Radio Corp. of America, Canton, N.Y.

Mark Skarup, Jr., vice president operations, Tustin International Inc., Tustin, Calif. Also Vice President S. W. Hart, long-time plant director, resigns to become Vice President of Tustin International. Schatzberg has set up his new division, Tustin, in the Far West headed by James J. Farnan, Components headed by Irvin Rodger Koenig.

William W. Bunkerhead, board director, Atlanta. Figitronics International Inc., Woodstock, Ga., has appointed W. W. Bunkerhead president.

Harold J. Pritchard, a director, Epsilon Corp., Greeley, Colo. Mr. Pritchard is vice president operations of the company's Greeley facilities.

John W. Nease, president and board director, Comptech Aerospace Systems Inc., San Jose, Calif. X.T.

Charles F. Hornig, Jr., president and board director, Matrix Optical Instruments Inc., Pasadena, Calif., and Stuart M. Horner, group president.

Robert L. Dickson, president, Walker Radios & Components Inc., Belleville, N.J., succeeded John F. Kehoe, now board chair man.

William E. Werth, executive vice president, and CEO, Corp. College Park, Md. Y.

John C. Clark, president, and Robert Duran, David M. Johnson, and Vicki Daniels, Las Vegas, Nev.

Robert H. Herbst, vice president and general manager, Electronics Division, The Ralph M. Parsons Co., Los Angeles, Calif., and Charles C. Goss, Jr., vice president and manager, aircraft division.

Jack T. Conley, vice president and general manager, U.S. Engineering Co., Van Nuys, Calif., a division of Litton Industries.

William M. Robinson, vice president and manager, Lockheed Corp., Thornton, Colo., now Los Angeles Inc., San Ramon, Calif.

Honors and Elections

The Hon. H. G. Nelson has been elected president of the Society of British Aircraft Constructors, Inc., 1980-81, succeeding Sir George Doherty, who becomes deputy president. Sir Roy Disney was elected vice president.

John H. Hollingshead has been named president of the Aerospace Operations Council of the Air Transport Area, and Carl A. Fornasier has been named vice president. Mr. Hollingshead is a president-elect of Eastern Air Lines. Mr. Fornasier is president of Pan American Airlines. Mr. Hollingshead is also president of the Conference Research & Development flight operations of Northwest Airlines. Fred D. Hall, vice president and general manager, manager of Trans World Airlines.

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INDUSTRY OBSERVER

► Douglas Model 2129 supersonic transport proposal is designed with wing tips that fold downward at Mach 1.0, cruise at about 70,000 ft, to improve directional stability. Wingtips would be lowered for good low-speed handling. Variable geometry wings and large wing tips for high altitude should enable the aircraft to use all airports now served by subsonic jets, and sonic-cruise costs to be comparable with current jet costs.

► Friends Minister of Transport has requested a meeting with the British Ministry of Aviation as soon as possible to spur joint development of a supersonic transport. Representatives of SNC-Aviation and British Aircraft Corp. probably will participate.

► Farnell Air Control has asked Lockheed Corp. for bids on fitting 21 F-104 aircraft with pods for folding fin rudders, which presumably could be used in both air-to-air and air-to-ground operations.

► Preference studies by General Dynamics Corp. Werth indicate the B-88 bomber could carry a combination of two Douglas Skybolt air-launched ballistic missiles, which would greatly increase its stand-off bombing capability, and two exocet missile空-to-surface missiles. Each bomber would have digital software to select one of the two missiles.

► Unival Technology Corp. is scheduled to ground test at least one week's worth of flight-test flight-test solid rocket engine designed to deliver 200,000 lb thrust for approximately 1 sec, although duration can be substantially longer. Developed under National Aeronautics and Space Administration contract, the engine has a mass ratio approaching 0.95 and a very large propellant with storage life can be as long as two years.

► Rollout of the first North American B-70 is scheduled for September, 1982. Plans for manufacturing management of the program will be presented that week, in Los Angeles, at the second meeting of the B-70 executive council, which consists of top Air Force officials and major contractor executives.

► New version of the Short Sessent aircraft model capable of launching a target in real visibility, is under development by Short Brothers & Harland. The Sessent's rate of production is stated to be:

► Machine capable of scaling Sessent test to a variety of type faces and converting it into human readable code at the rate of seven pages per minute will be integrated into a British Atomic Co. The machine was developed under Royal Air Force Development Center sponsorship.

► First Air Center space launch vehicle has been undergoing cold flow testing now at Cape Canaveral. Main purpose is to check the liquid oxygen/liquid oxygen/oxygen tanking system at Complex 16. Centaur stage which has been used for testing and ground equipment checkout, tests is scheduled for second flight test. Another Centaur stage will be used on the first flight.

► British government has agreed to allow the National Aeronautics and Space Administration to build a Project Mercury tracking station on Canton Island in the South Pacific, subject to parliamentary approval. All data is to be made available to the British.

► NASA's Goddard Space Flight Center will request proposals Jan. 26 for a data separation and analysis system to be used in connection with Goddard's space simulator. Draft of planned specifications for the system was presented recently by Vice Adm. Joseph C. Hawley.

► Air Force plan to put software of this metal threads in order to sense an passive communications satellite has been shelved at least temporarily by USAF Under Secretary Joseph Hawk. This action showed little concern that such a cloud of spurious weight phrase was of the Sones communications satellite, and objection that it can be timed by optical and radio instruments. This program, Project Windmill, originally was called Project Neelie.

Rolling Back the Heat Barrier

1600 1800 2000 2200 2400

The surging power of modern 20,000-spotted thrust jet engines is being harnessed effectively by critical parts made of HAYNES high-temperature alloys. Turbine and areas are typical of the hot spots in which these alloys serve. Here, in form of turbine and rotor, they resist the hot combustion gases as they pass through the various turbine stages. In these areas of extreme heat, such as afterburner liners, flame holders, shrouds, and liners of combustion chambers and nozzle cones, HAYNES alloys are reducing the damaging effects of long hours of high temperature. In fact, the use of the Air Force's latest 3800 MPH jets calls for different HAYNES alloys in vital parts where heat and stress would weaken and fatigue other materials.

Whether investment- or sand-melted, rolled, wrought, vacuum melted, or air melted, there's a HAYNES high-temperature alloy to meet your needs.

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Washington Roundup

Soviet Fighter Exports

Soviet Russia now is exporting its latest generation of operational supersonic fighters to Soviet satellite air forces and is posting first-generation supersonic fighters and jet bombers into countries with communist leaders.

East Germany, Hungary and Poland now have the Mikoyan-MiG 21, Armstrong-Flitwood fighters in their air defenses, while Soviet air-defense versions of the MiG 21 are appearing, too. MiG 17 fighters are the mainstay of the Egyptian and Iraqi fighter forces. Fremen jets have been shipped to Cuba. Russia has exported 12 Ilyushin MiG-17 Fresco fighters to Morocco and Flitwood trans-jet bombers to Indonesia.

Intense Soviet effort in intercontinental missile defense, coupled with U.S. progress in missile defense techniques, may result in early production for the Nike Zeus missile system. The Defense Department is expecting a memorandum to President Kennedy that the Nike Zeus system may bring production quantity funds for missile production without raising formally a question of weapons sales to the Soviet Union.

The decision is based on recent advances in missile detection, discrimination and data processing-plus growing evidence of an all Soviet effort in the missile defense field. One important aspect that concerns Administration officials is the propaganda advantage that would fall to the first country to demonstrate capability to kill an incoming ballistic warhead.

Domestic test the director of Defense research and engineering's office has in progress indicates of research studies has reduced the flow. Small improvements in a missile, not apparently because proposed studies are being turned down but because the reviewing process is so slow.

Sensible for National Aeronautics and Space Administration's new Manned Space Center, Houston, has been cited by the President's home state, Massachusetts. Houston, California, and Louisville already have bid for the facility, and Virginia has been fighting long to keep the nucleus of the manned flight group right where it is—a Virgin of Long, Long Ago.

Because he is chairman of the subcommittee which considers NASA's money requests each year, Rep. Alben W. Barkley of Texas has had a powerful edge in the fight but then an editor in Okla. is so poor for influence on Rep. NASA defense and atomic energy committee, it's time to be a consideration. Recently, he issued a statement for Texas constituents, saying his editor has found him sound despite remaining possible insolvent and unable to get his 17th term running 15 years from now.

Defense Secretary Robert McNamara, who has been forced to serve under Johnson in the past, has also concluded that the way to keep our service from running over with the bill is to play them one against the other and this has altered his ideas about the desirability of having only one service.

A major acceleration of development work on Space Nuclear Auxiliary Power Supply units is planned by the Atomic Energy Commission. Liquid metal is to be used in reactor units and solid metal in the subsystems, both to be reheat in front of TVA, and the reactor type is to be ready to go with a 2500 rpm. schedule by the spring of 1965.

Units will include panels for transmission of data lines, solid load bearing packages, for short lived and long living nuclear activation lights, and for unattended remote stations.

Concern over the appointment of Anna Gise, Maxwell Taylor as military adviser to the White House drew a pointed comment from President Kennedy. "It has given considerable bad will, but it was worth a full explanation." Now, when General Taylor's appointment is regarded as a continuation of the responsibilities of the Joint Chiefs [of Staff] which it is not," the President said. "But it came about as a result of a concession between the Joint Chiefs and Secretary of Defense McNamara."

Hughes designed to work out a federal policy on rights to inventions made under government contracts as, scheduled to receive late next month. Chairman Erastus Daddow of the House Science and Technology Project Subcommittee, was apparently heading in an overall government policy. His to success, he said, is flexible, rather than the current set of rigid and misleading rules, and he feels a flexible patent policy is clearly best for us.

State Department and foreign service employees covering the North Atlantic by jet aircraft will be required to travel on fixed routes or tourist class, beginning Aug. 17. Expected savings a \$200,000 per year.

Sen. George McGovern's hearings before the subcommittee on national policy making will bring back former federal agents back to town. William J. McNeil, who was Pentagon comptroller under Presidents Truman and Eisenhower, and Monroe D. Stein, who was President Eisenhower's last director of the Bureau of the Budget.

—Washington Staff

Zen Production

Space Center Scramble

Space Acceleration

More Patent Hearings



Bomb: Mach 2 heavy booster carries a ballistic-type missile similar to USAF Shrike along under its belly (note arrow) during Tushino air show. Missile is nuclear propelled, about 65 ft. long and is controlled in the landing belly with the guidance of the missile and its intended drifts till its release. Missile range is estimated at over 500 miles at a supersonic speed.

New Air-to-Surface, Air-to-Air Missile Types Are

Portion of Best long-range bomber-bomber flew over Tushino equipped with large supersonic, self-guided, air-to-surface missiles along with three specially modified bombers. Rear arm, formerly planned to bomb bombers has been modified to add range for missile guidance. Rear arm operational supersonic electrodirective missiles are now with MiG-40 on lead plane and MiG-21 on bottom plane.



Frontons of Tupolev Badger night-bomber shown carrying an exo-atmospheric missile exceeding USAF Hound Dog design with jet engine along under nose body. Maximum effective range of this jet-propelled missile is estimated at about 250 miles. Badger over has been modified to home guidance radar. Badger operational since 1958, formerly used on conventional bomb delivery systems.

Identified on Soviet Bombers, Fighters at Tushino

Closeup of the nose-carrying Badger shows design details of the Hound Dog type missile and the rear refuelling of the twin-jet bomber. Frontons of missile-carrying Badger flew at Tushino indicating the missile-bomber combination is in operational service.





Two advanced versions of Yakovlev Flashlight aircraft (note the Model B (below) all-weather interceptor equipped with large aircraft intercept radar in the nose, twin pt engines with afterburners mounted under the swept wings, and long air-to-air missile armament). Production version of Flashlight B shows minor changes over the prototype first seen at Toulouse in 1966. Attack version, Flashlight C (below) appears to feature repositioning of the 1966 fuselage prototype with armament, such as addition of venturi for boosting rate of climb and responsive swept engine intake. Both versions of Flashlight shown here at Mach 2.2 thus.



Two different Mach 2-plus prototypes (right and left) of new generation Soviet interceptor shown at Toulouse. Both planes are apparently Sotnik designs and feature a large single turbojet engine and delta wings but carry two different types of air-to-air missiles. Fighter at right has canard jet intakes with air heat along leading edge of delta wing and several mid-fuselage.



Formation of Mikoyan-Fulikhov Mach 2 delta-winged fighters is shown armed with a Schenck-type air-to-air missile mounted under each wing. Note large venturi for air intake in nose. Fulikhov was an operational version with Soviet air force as well as the satellite air forces of Poland, Hungary and East Germany.

Soviet Fighters Show Varied Armaments



Both designs shown above differ from the new Mikoyan design shown here (AWW July 18, p. 27 and July 17, p. 28) which carries smaller type missile and has two large turbojets with two intakes and a rocket engine fixed at between them at the tail.



Two types of operational interceptors are shown over Toulouse. Fulikhov flight carry three Schenck-type missiles one under the belly and each wing. Sotnik-designed Fitter (right) carry underwing pods under each wing and belly fuel tank.



Bausch Boney Bell two-seat fighter showing canards and canard-mounted stabilizers flow control in design approach with that of the Martin P5M. Bell's design is resulting in half the droop tail and less fuselage fineness ratio than the P5M but appears to have less tail controling with lower controlled problems. Engines appear to be mounted close abeam and the fuselage ends from the nose to the inside and the canards have sharp (below) may be designed to guard against water ingestion. Increases down fuselage makes the tail (below) may be attainable strategic airborne detection gear to provide a door for main laying or ejection of other stores.



Mil Flying Crane, in flight at Toulouse lifting a freight car road trailer, a derived from the Mi-6 but has a larger engine bays and longer blades needed for its mission. Crashed visibility has been increased with larger and more prominent windows and fuselage appears longer than the Mi-6. Circular cutouts below cabin port stand of the front landing gear is probably a telescoping compartment for a crewman to provide off viewing for cargo loading. The presents either forward- or off-centered of loads.



Fokker designed by Fred Sodder (above) uses instead main fin appears to be smaller module had made in smaller form. Fokker first flew in prototype in 1978. Testbeds are done and has been in production and operational service for several years as a day fighter. New Kaiser turbine-powered helicopter is shown (upper right) with curved rotor a large nose radome and two large anti-torque vertical stabilizers suspended from the landing gear on either side of the fuselage. Smaller piston-powered Kaiser Ka 10 (Heg Dancer left) is shown being transported with the larger jet-powered model. Kaiser also designed the Breguet conversion shown at Toulouse. Part of large French fighter formation (bottom) stands away from Toulouse during flyby in formation flight. Delta wing platform and missile armament are visible in silhouette. Visited the site in 1981.



Package Plans Call for 3,900 Missiles

By Larry Beeda

Washington—Air Force and Navy, under Secretary of Defense Robert S. McNamara to meet out earlier selected weapons program priorities fiscal 1967 have proposed that 3,900 ballistic missiles be issued by fiscal year 1968. The contractors, U.S. Army, from sub contracts that year.

The proposed break down sets 2,100 fixed Minuteman solid propellant intercontinental ballistic missiles, 415 nuclear Minuteman missiles, 275 Titan liquid propellant ICBMs and 720 Polaris solid propellant missiles.

Cost of the programs through fiscal 1967 would amount to \$1.7 billion for fixed Minuteman, \$1.7 billion for mobile Minuteman, \$1.7 billion for Titan and \$1.6 billion for Polaris.

These are the highlights of the first phase of "package" programs under consideration by Assistant Secretary of Defense-Controller Charles J. Hatch to provide McNamara with guidance in making decisions concerning future weapons actions.

First phase of Hatch's studies were limited in what he calls "critical war issues" which a revised announcement for long range nuclear delivery forces. Second phase which is due for completion in the end of this month, now certifies the general purpose forces.

This is a new terminology for what were formerly called "strategic war forces."

The first studies were confined to Air Force and Navy programs. The second would cover Army and Marine Corps programs.

Although Hatch's principal effort as far back as 1963, McNamara looks for decisions involving long range missiles as a resuming overhaul of the strategic budgeting budgeting machinery. Long term missile programs is the Defense acquisition organization has generally expressed concern over the ordered switch from strategic budgeting to program budgeting.

Full details of the changes will not be felt until the fiscal 1968 budget year when Hhatch plans to have programs costing identified closer to an specific impact area, with general support areas pointed among the programs. This was done generally in the first phase studies just completed.

Specific support cost were to be fixed as including such items as fuel, other supplies and administrative costs. General support costs include everything else, such as costs of general government administration and costs of operating the service laboratories and contract training schools. All of these are included in direct program costs.

McNamara now has the phase one studies in hand, and they have been distributed to the Joint Chiefs of Staff for study and comment.

There is no assurance that the proposed programs will be accepted by McNamara and the President. Many of the studies are up to criticism as being technically deficient in their form and approach. Comments concerning these points will be presented during the staff work of the Joint Chiefs of Staff.

For strength dehances of medium weapons, the Air Force has proposed the purchase of 51 more Boeing B-57 longrange bombers. Under present procurement guidelines, these would have costed at \$15 million each, a total cost per wing the 14 wings, plus seven backup aircraft per wing to take care of attrition and maintenance, twice the cost to maintain and evaluate.

The B-52 refueling proposal, submitted before recent negotiations in the Senate, that it would have favorably to requests for additional funds for renewed bombing calls for having another 51 B-52Hs. Current authorized strength is 18 wings of B-52s. Air Force would get around this by having a wing unit of replaced B-52B pilot identified as a wing but in effect an active combat unit. Thus, the total cost of B-52s would be \$80 million.

Cost of a fleet of aircraft in fiscal 1967 would amount to \$7.7 billion for the Air Force and \$2.275 billion for the Navy. Air Force costs would remain over \$7 billion through fiscal 1964, then drop to \$6 billion in fiscal 1965 and \$5.7 billion in fiscal 1966.

Navy costs would remain at \$2.1 billion in fiscal 1963, drop to \$1.5 billion in fiscal 1964, drop off to a little more than \$0.9 billion in fiscal 1965.

The Air Force total in fiscal 1962

includes \$1.8 billion for aircraft, \$2.9 billion for missiles, \$3.5 billion for maintenance, \$1.1 billion for military personnel, \$1.4 billion for research, development, test and evaluation, and \$2.6 billion for other items.

Principal programs are:

• B-52. Proposed cost would be \$2 billion in fiscal 1962, \$1.5 billion in fiscal 1963 and would decrease to \$1.3 billion in fiscal 1967. The aircraft are figured as costing \$14 million each.

• B-47. In fiscal 1962, \$3.8 million would go into the smaller jet bomber program, dropping until fiscal 1967 when only \$1 million is projected.

• Fixed Minuteman. This is programmed for \$1.3 billion in fiscal 1962, \$2.9 billion in fiscal 1963, \$2.6 billion in fiscal 1964, \$2.8 billion in fiscal 1965 and then rapidly drop off to \$1.9 billion and \$1.5 billion in fiscal 1966 and 1967, respectively. Total over the span of years \$12.1 billion, for a result cost of \$5.5 million each.

• Mobile Minuteman. There is \$2.9 million programmed for fiscal 1962, an existing \$270 million in fiscal 1963, \$535 million in fiscal 1964, \$545 million in fiscal 1965 and dropping to \$600 million in fiscal 1966 and \$534 million in 1967. Cost per missile is \$7 million.

• Titan. Programming for Titan began at \$2.2 billion in fiscal 1962, drops to \$160 million in fiscal 1963 and down to \$130 million in fiscal 1965. Cost per missile is \$11 million.

• Skorab. This is \$58 million proposal for fiscal 1962, with a rapid buildup in \$533 million in fiscal 1963 and a peak of \$483 million in fiscal 1966. It would then decrease to a little over \$100 million in fiscal 1967.

• B-58. Proposed cost is \$17.0 million in fiscal 1962, increasing to over \$230 million in the years following for a long program cost of \$1.2 billion.

• Polaris. Navy cost is 45 submarines, costing 16 million each. Development costs in the program for longer range versions would push the cost per missile to \$12 million. With 29 Polaris submarines already authorized or requested, proposals are for 10 more in fiscal 1963 and six more in fiscal 1964.

As proposed in the sessions, the program estimates are the more refined. One official describes them as "dodg" for the future, when costs will be more thoroughly programmed.

Some officers feel that there may be adverse public and congressional reaction to having the costs of expensive weapons systems revealed. Congressmen easily listen to the approach however.



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LEADERSHIP IN AERO/SPACE ELECTRONICS



**NEW
VAPOR
DETECTOR**
Warns instantly
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vapor danger

If you are concerned with missiles or missile fuel handling, consider these features of General Electric's Automatic Vapor Detector safety device.

IT IS EXTREMELY SENSITIVE. An alarm is activated on one half part per million of a toxic or explosive vapor can be detected.

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WARNING IS ALMOST INSTANTANEOUS. The sampling rate of G.E.'s Vapor Detector is approximately five times a second. **EQUIPMENT IS SIMPLE.** Only a pump, sampling unit and alarm are required. All functions are fully automatic.

This vapor detector has already been selected by the Navy for its space application, and can be tailored for any application where missiles or missile fuels are handled, stored or tested.

Here is another example of LHMED leadership in aero/ space electronics.

GENERAL ELECTRIC

Light Military Electronics Department
Schenectady, New York

Conflict-of-Interest Rules Issued; 'Selling' Is Described by Defense

Washington—Defense Department issued its first broad conflict-of-interest regulation last week, including a detailed description of what constitutes selling to a service or to its morale officers.

The new regulation has six parts. The first, "Personal military or civilian," lists "conflict of interest" which might be interpreted as a term to be applied immediately to the "Contractor," "Supplier," "Consultant," "Employee," "Contractor's family or dependents" or "consultants with an entrepreneurial enterprise" or "in an entrepreneurial enterprise" and an "entrepreneurial product." This does not, however, limit the term to the Defense Department.

• **Recent government and present, or**

an active duty can use their military skills in connection with commercial enterprises as long as such are done

without Defense or any of its

subsidiaries or contractors. This does not, however, limit the term to the Defense Department.

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• **Each military department is to app-**

point to official to oversee these new

regulations and ensure compliance.

Information is interpreted as influencing their interests. An "entrepreneur" which might be interpreted as a term to be applied immediately to the "Contractor," "Supplier," "Consultant," "Employee," "Contractor's family or dependents" or "consultants with an entrepreneurial enterprise" or "in an entrepreneurial enterprise" and an "entrepreneurial product." This does not, however, limit the term to the Defense Department.

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regulations and ensure compliance.

Rickover Urges House To Abolish Air Force

Washington—Vice Adm. Hyman G. Rickover, director of the Navy's nuclear reactor program, has advised Congress to abolish the Air Force, instead the Navy, as a means of saving money on aircraft carriers, said that National Aerospace and Space Administration is instrumental in establishing the independent contractor system, and changing the industrial participation in the nuclear reactor program.

Further Limitations

The directive also has an other "fission answer" with a new method of ultimate communication of a sale, even though the actual contract is subsequently negotiated by both sides.

The section on selling states that "It is not the intent of this directive to preclude a retired officer from accepting employment with private or quasi-public entities because his employer is in conflict with the government."

An officer who has served at least eight years before resigning or being released from his service, and who has a job offering to a Defense agency, must file a detailed statement of his background and intentions with the secretary of the service with which he plans to deal.

The directive includes these other provisions:

• **Defence personnel cannot accept an**

host, guest, or entertainment

or entertainment

other service anything else or value

to get career. In USAF visits from

the airplane to the state. Adm. Rickover said the Navy is taking it over and

"I see that the Air Force does not get jet."

Although in NASA, Administrator James E. Webb and other top NASA officials have pointed out that there have been difficulties in NASA's managing the space plane. Adm. Rickover said that underlines difficulties in managing the space plane.

Commenting that "NASA does not even have a mortal index of all its informants, and continued research and development projects are in process," he added: "We are about to spend over billions of dollars in the space program. We must see to it that all information U.S. and foreign in research is available. Otherwise, there will never be deployment, delay, and added cost."

Adm. Rickover justified Rickover's position on the capitalistic practice of rewarding and punishing individual invention and making patent information widely available. "It is one who can invent, profit from it, and profit from it," he said. "I think that 60% of all patents in the U.S. is wasted because it is not used."

He recommended that "there is no such thing as collective thinking, as a corporation. All thinking takes place in a single mind."

He also observed that "Washington, D.C. is the only place in the U.S. where all patent information is available."

Noting that about 100% of the time the used nuclear reactor program is purchased as a "turn-around," he added: "It is a complete, finished product. It is not a component. I am surprised that some engineers don't like it."

Swiss Bloodhound Order

Gen. Sirs in United Council, rating heads of states and heads of governments, are invited to make application for a subscription for the Swiss Bloodhound.

Swiss Bloodhound is a subscription (SW 100 77, p. 23). Proprietary to Parliament however, is not expected to fare for end of the year.

The Bloodhound service, which is still being developed, some time ago will provide the Swiss with their first nuclear surface-to-surface missile. It is apparently being financed through a credit. On hopes of selling the Swiss Bloodhound to Switzerland as its standard anti-aircraft missile system.

Although not officially announced, the value of the Swiss order is estimated at approximately 500 million British. An official Corp spokesman in English said only that it would be "considerable" larger than the recent Swedish order for the Mark 2 Bloodhound.

Competition Forces Trunk Excursion Fare

Drive to fill growing seat capacity produces rate cut; may push coach business to more dominant position.

By L. L. Deti

Washington—Competitive drive for new routes to offset the domestic trunkline industry's declining seat capacity has forced introduction of the first major domestic excursion rate in recent years, which is expected to push coach traffic into an even more dominant position than it can hold.

Last week, Trans World Airlines filed a tariff with the Civil Aeronautics Board calling for a coast-to-coast jet round-trip excursion rate of \$198 and jet-engine excursion rate of \$175, lowest date offered on this route or recent years. American and United later announced they would file a similar tariff. American clearly stated it was filing only because it was forced to do competitive reasons.

United touted the excursion rate a "workable experiment," which it hoped would create new market sectors. The airline said it would "encourage" the plan's continuance.

Nevertheless, both United and American are known to be somewhat opposed to any further rate reductions at this time, as the grounds that the volume of coach traffic should be given beyond profitable proportions as a result of discounting effects on trunkline traffic.

Luring Highway Travelers

TWA felt the new fare will not have passengers move from standard service but did allow some customers away from the highways (AW, June 1, p. 58). The airline says this is addressed by requiring purchase of domestic tickets to travel between Monday noon and Friday noon and to return not less than 12 days after departure. Business travelers, TWA reasons, will find these conditions impacted.

American's philosophy is that before fares can be lowered in an effort to new business, there must be some differentiation that the airline is being. American can accomplish that through the licensing of fees for its available traffic, with fees to those given discounts.

United has consistently held that the gap between coach and first-class rates has been too wide, and the current low is a successful industry drive last year. American says its 25% of domestic fares to cities earlier this month by United America to date, route rates to 55% of first-class rates has been suspended by the Board.

Since June, 1968, when coach traffic expanded 15% while revenue passenger miles for the first time, coach seat

Although the industry had factors in force favoring the 80 seats for the first time in route numbers, the 61.15% load factor achieved was 5.99 passengers less than that recorded in fiscal 1960. In the much enlarged June 1, 1970, increase in available seat miles for outstripped the 20% increase in revenue passenger miles to drag the industry's load factor down to 69.1% from 70.1% before the 72.1% level reached the previous June.

First-class available seat miles dropped 5.4% in June, but first-class account passenger miles dropped 12.7%. Result was a 3.9% dip in first-class load factor for the trunkline last month.

Only three carriers—Eastern, North and Northeast—registered gains in first-class traffic last month. During the same period, only Northwest showed a diposis in coach traffic. All but Northwest and Western increased coach available seat miles, and only Eastern, Delta, Northeast and Northwest increased the available first-class seat miles offered.

Business Coach Gains

Eastern recorded the largest monthly gains in coach traffic, to June with a 10.7% increase over the same period last year. United, which had available coach seat miles by 4.4%, reported a 3.1% increase in coach traffic during the month.

United was joined with Capital Airlines, was the only one of the three transcontinental carriers to show an increase in total revenue passenger miles in June. It had a 9.5% gain, compared with losses of 6.4% for American and 4.5% for TWA.

Eastern total revenue passenger miles rose 4.5%. Delta recorded a 10.9% increase and Northwest declined 1.1% during the first period. All other carriers showed declines in revenue passenger miles, ranging from five to 11%.

In June, 1961, none of the 11 trunkline carriers had coach traffic than first-class traffic, compared with six of 12 last year. National attributes its high position as a coach operator to the increased capacity of its jet fleet operating in a possible coach market. New York, Florida, National's coach available seat miles in June were 44% as the carrier opened new routes to California.

TWA has been expanding its trunkline routes for several years but has conducted a two-edged promotional campaign during this period, award at both

coach and first-class markets, in order to prevent an excess diversion to the lower fare and greater profits.

Eastern's 7.4% increase in coach available seat miles can be attributed in large part to its late date on the heavier competition between Boston and New York and New York and Washington. In this connection, it is interesting that the two cities in which less than half the total first promotional expansion in the past few months is believed to be the only two responses to trip rates in the trunkline industry—Eastern President Melville A. MacIntyre and TWA President Carter C. Young have had.

The Board has assumed a non-cooperation with the industry began in June 1968 with a diposis in coach traffic from the July 11 meeting. The flight controller was undeterred, the case survived and only those 100 airlines use the accident and were questioned during the performance investigation. The pilot, Capt. John Glaser is expected to have made a general handbook claim to the carrier disclosed with all of the 10,000 flights around about of June.

Investigation of the DC-8 accident which killed 17 people is restricted to DC-8's loadable revenue and flight record.

Techniques used will be the pilot in the cockpit and seat.

Flightdeck and aircraft services will be available at Denver's Stapleton Airport.

United DC-8 Denver Crash Data Sifted by Government Searchers

Initial investigation of the jet, about 15 days after it took off from Denver with 122 passengers and crew, indicates that Capt. Glaser noted a fluctuation in the hydraulic pressure indicator and called Denver Air Route Traffic Control Center for clearance to turn out the eastbound turn. A spokesman, reporting power to the Victor 4 area, informed Glaser, Cole and Denver, who checked out an "abnormal" hydraulic situation. He also reported that hydraulic pressure and quantity were holding and continued to Denver. Denver approach control cleared him for a landing to the east but Glaser asked for a straight-on approach to the west on runway 26 left.

Wind Negligible

Since the wind was almost negligible and traffic light, Glaser was granted a right turn. Glaser turned to the east and the landing was made with a clearance obtained from the right about 1000 feet. According to Glaser, he calculated that a 10-kilometer wind would be less than acceptable. After roll out about 1,000 feet, a number of tires on eight wheels of the main landing gear blew out and the airplane moved sharply to the right and off the runway into an area of new construction. Six

Fare Increase

Passenger fares within Western Fares will go up by 5% Nov. 1.

New increases are being put into effect at an annual rate of 4.75% for Pacific Northwest fares, which are the highest fares in the country, and 4.5% for the rest of the region, except with 10% increases. According to rate claim, the model did not reach the crack since until 10 years after the crack but Denver, Marin, Oaksterdam and San Jose were reaching at the same within 45 days after the plane stopped.

Parts of the western region, will stay in the United Air Lines mainline revenue base at San Francisco when that area being analyzed in the passenger and revenue groups. The breakdown to new fare increases, which are the highest fares in the country, and 4.5% for the rest of the region, except with 10% increases.

Passenger and carrier are not included in the agreement.

K. A. Kostikas, SAS vicepresident and chairman of the fare meeting, said the highest fare structure was necessary to accommodate for recompensation of new cost factors.

Meanwhile, an informed DC-8 owner in London's North Atlantic carrier decided to take an action on certain services to lower fares on the North Atlantic.

Coach Share of Trunk Traffic

Carriers June 1961 June 1969

Carrier	June 1961	June 1969
National	50.5%	37.2%
TWA	46.5	48.1
United	59.1	48.7
Frontier	59.4	59.5
Continental	57.6	49.2
Western	57.4	49.5
American	58.6	48.7
Northeast	52.3	68.5
Southern	52.0	58.1
Delta	46.6	42.9
Eastern	45.8	38.7
Average	57.9	49.0

* Includes United and Capital combined.

Tu-114 Record Claim

Moscow-Soviet claim there was world record flight. During the flight, the Tu-114, the first of a flight from Vnukovo Airport, in which the high-speed transport aircraft had a 20,000-kilometer load to an altitude of 44,125 ft. A Soviet record was claimed for lifting loads of 26,25 and 36 tons. The aircraft was piloted by 2 Sovietmen during the 1 hr 22 min flight.

of the right tires were found to be blown after the crash.

The airplane plagued seven two-class low-dishes, losing all three landing gear struts and struck the concrete foundation of a new grower and a parked service truck.

The airplane was shedding sharply in the altitude, flaring up a series of fast dives at the end of the runway and came to rest on a berm 110 deg to the right of the runway heading after sliding nearly backward for the last several feet. It did not catch fire immediately and a number of passengers left the airplane safely by using the emergency slide at the front left passenger door. The slide was later recovered by the fire. Most of the crew escaped through the rear passenger door. Carbon monoxide poisoning and asphyxiation accounted for most of the fatalities aboard the airplane. The fire fighter completely destroyed the left wing and the left side of the fuselage. Apparently the left side of the fuselage was collapsed by the carbon monoxide fumes. The right inboard engine was the only one which remained attached.

The airplane was a relatively new DC-8, serial 146, on the Douglas production line, and was delivered to UAL on June 15, 1961. It had logged an estimated 125 hr of flying time at the time of the accident.

In a Washington press conference later, Nipsey Holden, administrator of the Federal Aviation Agency, released a list of 73 DC-8 hydraulic system and hoses over the past two years. Asked whether the number of malfunctions was enough, Holden said, "I might say yes." Douglas officials referred to comment, but Douglas engineers were cited in private. They said that if similar hoses were released for Boeing and Convair jet transports, the figures for the DC-8 would be found to be quite formidable. They said hydraulic systems are always troublesome and the dataset need more than another finding.

Hubbs also sent telegram to DC-8 operators in the United States asking hydraulic emergency procedures in the FAA-approved replace manual for the DC-8. The associated procedure is intended to conserve pressure in the basic hydraulic system during the recovery of the landing gear after a hydraulic failure. It is the same as the original procedure except that the landing gear control handle is immediately moved to the uplocked/checked position after it has been placed in the down position. After about 60 sec, the handle is returned to the down position.

The procedure of letting the landing gear free fall with the control handle in the uplocked/checked position minimizes rotation in the extension return line of the brake system and the

landing gear position control system which relieves a slight brake pressure automatically applied when the landing gear is released between the retracted position and the extended position. The purpose of the automatic brake pressure is to stay the rotation of the wheels as they are rotated so that passengers will not be exposed to the possibility of being bounced sideways. The pressure is ordinarily not more than 200 psi. A full inflation can be up to 7,000 psi.

Design of the DC-8 hydraulic system includes an elaborate array of back-up systems and fail-safe features intended to prevent hydraulic failure from having catastrophic results. If pressure is lost in the main hydraulic system, check valves prevent fluid from flowing out of the bulk tanks.

Pressure is maintained in the brake circuits by a pair of accumulators and can be used for slowing as well as stopping. When repeated brake activations have exhausted the accumulators, the pilot can operate a hand-handle to apply emergency pneumatic braking in both main landing gear areas at ease.

Boyd Warns Reappraisal Needed Of U.S. Bilateral Air Agreements

Civil Aeronautics Board Chairman Alvin S. Boyd has warned that inter-national bilateral air transport agreements and the conduct of all parties to the agreements must be re-examined. Calling for drastic action to prevent wrongdoing, Boyd said, "We must not be hoodwinked and must be educated to be informed and inspired in the one hand, and to take action over the other hand, in some tragic manner, which carries all taking advantage of the terms of their agreements with us." He spoke to the Commonwealth Club of California in San Francisco.

The speech generally does pose from U.S. international airlines but was an absent cause of concern to representatives of foreign flag carriers in Washington. In the past, Boyd has been critical of the bilateral principles and has publicly suggested that the best for a series of these principles lies at the door of the airlines.

Observers here believe the tone of the San Francisco address is similar to the recommendations on international air transportation contained in the Project Tammem report, which is now being evaluated through government traffic statistics for comment.

Boyd admitted in his speech that U.S. carriers are continuing to hold a large percentage of their passenger traffic but added "heavy awards are being made into it, improperly in my view."

permits landing not be prohibited in precisely the regular routes but the air-service routes is nonoperative and the blocks cannot be applied over track at a time for directional control. If the pilot needs pneumatic brakes, he must rely on throttle-thrusting. For directional control and roll-thrusts, steering device indicates when used.

Although the aircraft has pressure, but when the check valves to isolate the brake system, the two 7.5 in dia hydraulic accumulators store about 750 cu in of fluid at the system pressure of 3,000 psi. According to the specifications for the DC-8, this reserve is supposed to be adequate for four full activations of both wheel brakes if the brakes are heavily worn. In a new airplane, such as that in the Denver crash, there should have been enough reserve for eight full activations. With careful use to avoid cycling of the hydraulic system or frequent release of pressure on the brake pads, the reserve could be used to last about indefinitely. Investigation reported heavy load marks on the main and no fatigue has yet been found in the brake contacts.



ORL YERUSHALAYIM, left, chief of Soviet civil air operations to the United States, and JAMES M. LANDS, special assistant to the President at the start of U.S. USSR civil air negotiations.

Soviet Bilateral Talks Open on Amiable Note

Washington—Negotiations between the U.S. and the Soviet Union on a bilateral air transport agreement opened last week in an amiable atmosphere, suggesting that agreement for reciprocal air services between New York and Moscow will be reached within several weeks.

Through an informal exchange of notes between the two transport agencies, the two basic main interests had been reached prior to the first formal talks began. Essentially, only technical matters concerning the operation remain to be ironed out during the course of negotiations.

The Russians appear eager to begin the negotiations and evidently will conduct their operations in close liaison with International Air Transport Association standards although they are not members of that group. Headed by Colonel General Yerushalayim of the Civil Air Fleet attached to the Council of Ministers of the USSR, the Soviet delegation includes V. M. Danilevich, V. N. Kozin, K. V. Logvinov, V. S. Gerasimov, A. V. Lebedev, S. S. Pashov, G. V. Vashchenko and A. K. Stenov.

The U.S. delegation is headed by James M. Lands, special assistant to the Project Tammem Member of the delegation from the State Department, and Edward A. Bullock, ex-chairman of the delegation. Carroll T. Cole and Ed

win Kilburn, Civil Aeronautics Board representative, Chairman Gerasimov and James M. Lands, Civil engineer and Russian Minister of Transport, Andrei A. D. Marin, Jr. make up a trio of commissioners for Transportation and Edward J. Driscoll of the Defense Department.

Russell B. Adams, ex-president of Pan American World Airways, is acting as observer.

BOAC Strike Settled; Full Service Restored

London—Strike by British Overseas Aircraft Corp. maintenance workers ended last week after BOAC's London operations were shut down despite the intervention of the British Council of Labor and the National Joint Council for Air Transport.

Wingfield returned last Wednesday and the unions accepted to let him recall all operations over the weekend. A second week of the proposed plan had been recommended by leaders of the Amalgamated Engineering Union and Electrical Trades Union.

One of the strike was a BOAC job assignment plan involving consulting, design, formation and inspection jobs on a single inspection position (Wing 16, 17 & 18) in the maintenance sheds. About 1,800 men were on duty during the strike.

The walkout strike resulted in diversion of BOAC flights to competing airlines such as Pan American, Trans World, Qantas and Air India.

United Suggests FAA Blocked Private Study

Washington—United Air Lines has suggested that Federal Aviation Agency tried to block an independent study of air navigation out of the New York area when a Super Constellation DC-8 craft was scattered in the tail of 125 birds Dec. 26.

Ordered in United in March, the study was conducted by the Illinois Institute of Technology. It called for a detailed analysis of the Cobs Neck, VOR, localizer, one of several stations that is the point of the United DC-8s has been using in its last position when the jet collided with a Trans World Airlines Super Constellation.

In a July 7 letter to James P. Pyle, FAA design administrator Charles P. Melchers, United's senior vice president, said:

"The fact that one proposal after another has been made by Civil Aeronautics Board representatives in regard to that apparently your agency was not interested in pursuing this investigation. We believe that the public will not accept a proposal from TAA [Trans World Airlines] that it would not fit into your proposal. We believe that if it appeared their proposal would favor the basic 'fixes' you, satisfied us on the part of the FAA of the government.

Taking issue with United as FAA spokesman Bill Averitt, Wink said that "as far as I could tell," the agency had failed to make all necessary investigations if United still wanted to study the Cobs Neck VOR failure. However, the action taken by FAA indicated that United had lost interest in this aspect of the study and that CAB had been informed, he said.

The existing, however, United and TAA have been unable to make the second stage of the public hearings on the issue of the New York terminal scatter to be open here. At the moment, it is noted, last week, more than 20 air traffic controllers were withdrawn. When the first stage of the hearing closed in New York, five January (Jan 16, p. 38 and Jan 23, p. 40), CAB will begin the testimony of 27 witnesses during eight days.

It appeared certain on the eve of the proposed hearing that flight records tape data from each jet flying through the area just prior to the collision will not be ready for the record. About 100 of the tapes were prepared by CAB and in the event of an official exhibit, the witnesses will be given the chance to question the data's accuracy and relevance.



Left: Shell engines from Electrajet are at the AmocoShell Turbine Fuel Equipment Laboratory—left in the U.S. Right: New Lockheed Jetstar aircraft Shell sold in over 100 million gallons of turbine fuel last year.



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Japan Air Lines Receives First Convair 880-M

First Convair 880-M transport of a five plane order has been delivered to Japan Air Lines by General Dynamics' Western Group. Plane has been named Salure in Oliver Hobson by the airline. Second and third 880-Ms will be delivered to JAL before the end of the month. Final two transports will give the carrier's fleet a total of 18 planes. Interior of the 99 passenger plane was decorated in a Japanese motif. The General Electric CF665-1B powered aircraft initially will be used by JAL in a Tokyo/Hong Kong/Honolulu/Singapore route.

Northwest Pegs Profit to Cost Controls

By Glenn Garrison

New York—Tight cost controls helped Pan American Airlines share a net profit of \$12 million for the first six months of this year compared with a loss of \$224,000 for the same period of last year despite a drop in gross operating revenue because of strikes which curtailed operations during part of 1961.

President Donald W. Neppel, told members of the New York Society of Security Analysts here last week that the improved results for the 1961 period reflected \$42.971 million in operating expenses for the 1960 period.

Neppel, in his annual report to stockholders, said Pan American's operating profit for 1961 was \$7.93 million, compared with a loss of \$1.66 million in 1960 while net \$41.971 million operating revenues, \$554,000 operating profit, \$554,000

The airline maintains a series of real tough budget controls. Neppel said with monthly budget reviews. Neppel was a total operating costs per available ton-mile according to figures presented by Neppel to the analysts for several years have been among the lowest, ranking among the lowest in the industry, he said.

Neppel also cited the results of a recent reorganization. But the numbers were back to normal speed April 1. On Northwest's route load factors are good now and there is little in its resistance to the part of the public. Direct operating costs now average about \$1.25 per mile, comparable with the DC-8 and further reduction is expected in the future.

Direct operating costs of the airline's DC-8s are \$1.25 per mile. Neppel said. This is high and reflects the steady period when the inflation rate on the ground, causing no money but jacking up depreciation costs. Scheduled airline

of the DC-8s next month will be 30 in 15 min. daily average. Bidding 7200 utilization will be about 10 to 12 min. The Electra utilization now is slightly less than 9 hr. and the DC-8 utilization is slightly less than 8 hr.

Reporting the 7200, Neppel said he expects full utilization of \$700,000 revenue, with New York/West Coast fuel economy of 10.5 mpg, to go with the 7200 then with straight utilization.

Asked of the effects on Northwest of the United Capital merger, Neppel said United is a strong competitor and "possibly" United Capital just fits the way they are." But Northwest should compete adequately with United, he said. On the Seattle/New York route, Northwest carried 65% of the passengers in 1957-1958 and 1959 where it competed with United, Neppel said.

Northwest's Electra, not intended to compete with United, said Neppel. "Stop said, "The Electra will serve short-haul routes where the Convair could not make money." While the Convair and 7200 compete, the 7300 will serve the Cascades routes of the west.

Reporting future traffic growth of the industry, Neppel predicted a rate of 5-12% annual basis two to seven years. In addition, long-haul routes will provide much needed revenue for travel. At said Northwest's own growth rate was about 14% a year from 1954 through 1959, which he doubts will be repeated about 10% in the next few years in more bleak.

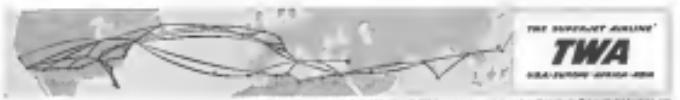
Neppel said he expects further mergers in the industry, within the next few years. However, Northwest's growth has no major or significant plan under consideration, he said.



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Airline Traffic—May, 1961

	Passenger Passenger Miles (2001)	Revenue Passenger Miles (2001)	Passenger load factor %	U.S. Mail Tons-Miles	Express Tons-Miles	Baggage Tons-Miles	Total Revenue Tons-Miles	Domestic load factor %
DOMESTIC TRAVEL								
American	445,545	497,399	48.8	1,290,103	1,312,108	11,326,272	41,320,272	48.8
Delta	371,072	38,489	50.2	414,459	541,344	10,566,918	45,444	48.5
Capital	279,482	114,216	49.1	612,420	491,441	13,294,077	44,878	48.5
Continental	311,444	71,616	48.5	203,877	113,485	4,975,127	27,227	48.7
Delta	310,223	173,918	49.2	400,512	544,059	11,204,234	48.8	48.8
Eastern	457,457	218,157	48.7	1,129,556	8,214,316	33,500,000	48.8	48.8
Northwest	92,661	49,391	48.8	172,476	32,517	384,676	1,206,360	48.8
Northwest	142,861	47,878	48.8	110,742	43,119	3,248,760	4,308,419	48.8
Northwest	140,205	75,564	48.8	110,742	43,119	3,248,760	4,308,419	48.8
Trans World	391,554	150,487	50.1	1,474,150	657,319	4,371,504	10,200,000	48.1
United	616,331	207,740	49.3	3,196,340	1,246,220	3,849,314	6,236,239	48.1
Western	107,745	47,479	50.4	276,310	10,792	340,218	6,402,736	48.2
OVERSEAS TRAVEL								
American	2,107	2,422	50.8	8,054	804	367,121	8,555,858	50.8
Delta	7,181	17,733	48.9	76,072	181,209	1,492,349	20,472,209	48.9
Continental	11,111	10,891	48.8	2,435	2,435	1,000	23,326	48.8
Delta	11,211	7,711	48.8	516	8,741	115,246	33,229	48.8
Eastern	31,730	36,890	50.3	173,119	496,434	3,194,335	45,571	50.1
Mexico	11,114	2,400	51.1	—	198	1,108	520,220	50.8
Northwest	15,674	10,169	50.3	1,698,020	4,128	2,046,850	21,637,137	50.8
TRANSATLANTIC								
Alaska	5,304	5,335	50.6	38,070	3,214	171,932	373,046	50.7
Atlantic	126,471	211,947	49.2	2,168,203	6,351,203	29,372,186	49.7	49.7
Caribbean	8,441	8,441	48.8	2,249	2,249	1,000	2,249	48.8
China	1,221	1,221	48.8	—	—	—	—	48.8
Pacific	41,881	19,844	49.2	2,780,210	12,048	2,684,034	34,146,849	50.0
Panama	7,744	16,305	50.3	554	554	3,498,146	54.0	50.0
South Pacific	7,744	2,273	49.8	219	194	40,422	50.4	50.4
South America	4,711	16,311	50.1	221	221	2,100,000	2,322,231	50.4
Trans World	35,605	31,348	49.4	1,023,114	7,722,024	31,395,129	52.3	52.3
United	11,000	19,212	50.2	107,440	2,145	349,359	5,473,341	50.2
Western	3,172	2,709	49.6	72,348	—	36,645	426,643	50.1
LOCAL SERVICE								
Allegany	PT 672	15,701	49.8	23,499	41,000	71,264	4,386,886	50.1
Alaska	32,782	4,022	49.2	1,345	1,345	1,345	4,345	49.2
Colombia	2,720	2,720	49.8	14,297	14,297	1,000	29,298	49.8
Frontier	39,351	7,354	50.5	32,138	18,120	42,481	418,026	50.4
Latin Central	31,234	6,291	50.7	11,340	20,159	14,338	400,993	50.1
Midwest	11,174	11,174	49.2	29,200	20,200	21,100	1,100,500	49.2
North Central	11,209	11,209	49.2	4,478	4,478	1,000	1,260,441	49.2
Northwest	11,073	9,764	49.3	20,540	20,540	37,003	948,411	50.1
Pacific	40,859	7,728	49.7	16,050	4,454	8,893	950,850	50.9
Panama	43,232	7,661	49.5	13,346	13,372	24,451	198,000	50.9
Panama	22,743	5,234	49.8	20,215	12,215	22,215	22,215	50.6
Trans-Texas	37,601	6,254	49.3	20,316	71,140	43,804	67,141	50.4
West Coast	31,852	7,233	49.5	18,350	3,559	34,943	765,448	50.9
INTERISLAND								
Alaska	34,709	1,433	41.3	5,210	—	3,264	249,832	49.1
Hawaiian	34,193	2,197	49.5	8,249	187,983	310,946	50.1	50.1
CARGO UNITS								
American and American	4,273	18,624	49.8	16,438	28,476	234,482	326,482	49.7
Flight Logo	—	—	—	—	—	7,701,203	7,746,027	78.3
Starboard World	3,123	15,234	50.2	1,092,140	8,470,269	6,915,051	44,66	44.6
West	7,477	10,164	50.4	—	—	1,334,173	2,351,371	50.3
HELICOPTER UNITS								
Alaska Helicat	31,176	3,089	49.3	1,343	—	143	38,837	49.7
Los Angeles Helicat	3,113	141	50.2	5,104	3,489	91,951	44,66	44.6
New York Helicat	31,126	223	51.1	1,498	918	34,977	34,977	44.8
AIRLINES USED								
Airline Airlines	8,377	8,192	49.8	44,057	2,345	307,448	1,932,016	44.6
Alaska Central	3,779	462	49.5	4,072	4,072	70,312	71,173	49.2
Carib	2,691	2,691	49.7	4,237	4,237	1,000	1,000	49.7
Edna	4,419	399	50.1	1,933	—	8,840	34,379	43.8
Kralash	7,212	70	49.7	440	—	1,025	8,254	44.6
Northwest Consolidated	3,342	3,046	50.1	24,430	—	76,748	347,183	44.9
Northwest Airlines	1,230	51	50.1	14,327	14,327	20,200	1,144,200	44.7
Pan American	1,345	1,427	49.2	45,846	12,644	107,657	388,157	44.8
Pan American	419	12	50.1	763	—	378	3,200	73.0
Western Airlines	8,926	1,108	49.4	37,308	—	126,444	384,903	44.9
West Alaska	—	—	—	—	—	—	—	—
Armen	7,340	349	49.8	924	—	219	34,563	49.7

Not available
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.



Pioneers in mission management



responsive bombers



space exploration

LEAR INSTRUMENT DIVISION • 110 IONIA AVENUE N.W. • GRAND RAPIDS, MICHIGAN

MARK II, III, IV—powered its preprogrammed projects by the Flight Control Laboratory of the USAF Aerospace Systems Division. Each objective, a functional application of the man-machine concept, finds a wholly integrated control and display system, designed around the capabilities of man and his need to achieve the ultimate in mission management. And, today, on the threshold of space exploration, the completed X-20/Cycle Mark IV project has provided experience and technological know-how to the Air Force, a comprehensive systems capability to "manage all" the control/display requirements for mission management to take man...

to the moon
and on beyond

SHORTLINES

• Civil Aviation Board: Examiner Curtis C. Henderson has recommended that Delta Air Lines streamline its association with the airline to allow one-stop service to Tulsa, Chicago and St. Louis via either Springfield or Peoria, Ill.

• Continental Airlines will expand its capacity of its maintenance base at Los Angeles International Airport to accommodate the airline's four Boeing 737-200 transports scheduled for delivery next spring. The \$8 million expansion will house three jet aircraft simultaneously when completed in March.

• Ed. James L. Goddard will serve as Federal Aviation Agency's civil engineer for another two years, heading the Aviation Medicine Service.

• Eastern Air Lines will double its nonstop schedule flights between Boston and New York after Aug. 1. Eastern will fly 18 flights daily in each direction on flights between 7 a.m. and 11 p.m., compared with eight flights not scheduled.

• Frontier Airlines, one of two local carrier names being favored projects against Civil Aviation Board's classификаion rate, has withdrawn its objection and will be part of the subcommittee for the service committee to list Jan. 8. Central Airlines is still pursuing the class rate.

• Horn Air Lines will receive one Convair 880 jet aircraft next January, and a second next spring in April, 1962. The aircraft will be used on Boeing's European and African routes.

• International Air Transport Area has adopted a standard aircraft traffic agreement for passengers and cargo aircraft handled between North America and the Orient or Australia to insure one service to the other. Under the agreement, IATA member carriers can designate the shipping companies and the Transpacific Passenger Conference with whom they will exchange programs.

• Military Air Transport Service has awarded \$2.5 million in contracts for transportation of overseas passengers and cargo during four July and August 11 flights.

• Van Gorder has been named chairman of the new United States Travel Service. He was associated with Pan American World Airways 1948-49 and he currently operates travel facilities in the Southern Pines, N.C. area.

AIRLINE OBSERVER

• Appointment of James M. Lands, special assistant to the President, to lead the defense negotiations with the Russians on a bilateral air transport agreement is prompting the Indians to ask whether the White House intends to take over all defense bilateral negotiations, hitherto a function of the State Department.

• Watch for a move by Scandinavian Airlines System to cut its payroll by as many as 2,000 employees in its new management drive for greater operating efficiency. Reductions will be conducted principally to the more maintenance and operations base area, where complete and departmental unit transfers of the classification requirements that Domestic Schedules and Systems each participate in SAS activities. In certain countries, SAS will be required to eliminate its own spare part stores, among other changes.

• Cuban Airlines is having serious financial troubles. One month after the airline started its intra-Mexico service, flight frequency was cut from one a week to one flight round trip weekly. Cuban government reportedly is forced to use its own reserves funds to help the carrier meet its own payroll. Financial difficulties stem chiefly from the fledgling carrier's underfunded equipment and state programs (AW Dec. 32, p. 38). However, the Cuban government apparently is still willing to undertake substantial loans in order to make Cuban Airlines the dominant carrier of independent Airlines.

• Indian Airlines Agency has recommended that Congress make available, financing and other acts of valuable federal funds if they are needed to assist in airline mergers in interstate commerce. Civil rights bills by the Administration now in the FAA press campaign against such offshoots. These court actions entailing \$1,000 penalties have a final appeal indefinitely delayed as "deadlock fails" to adjudicate N.Y. T. 1860.

• Beyond of sightseeing flights is a series of airshow flights aircraft is sponsored. American Airlines is conducting Lockheed Electra II half-hour flights in a series of cities as far west as Los Angeles. The airline plans to offer Boeing 707 sightseeing flights in Dallas. Midwest Airlines is operating additional bimonthly round flights with increasing success. The local carrier charter's a DC-9 for \$1,000 a \$65 charge which includes birthday cake and favors. American estimates that 30% of its sightseeing flight customers are first riders.

• Northwest Airlines is negotiating with Boeing Co. for three Boeing 720B turboprop transports in addition to the six it now has on order. Under the plan Northwest will purchase one additional aircraft and lease two from Boeing.

• U.S. has granted India totaling \$29.3 million through the Development Loan Fund to the government of Ethiopia for various projects. Of this total, \$2.2 million will be used to build a large four-story, 100-room hotel and 22 modern apartment, and \$3.1 million will be used to procurement of maintenance and medical equipment and for some parts for Ethiopian Airlines.

• Federal Aviation Agency has purchased an automatic telemarketing system from North America Philips Co. for installations at Anchorage, Alaska. Flight plan, weather information and air traffic control reports will be fed into the system via the 66 FAA and other stations and will be punched automatically to the proper receiving station. The system will implement the present process of accepting a punched tape and manually placing it into the proper circuit.

• First complete drafts of reports prepared in Project Horizon and Project Beaufort task forces have been distributed to the Defense Department, Bureau of Budget, Civil Aviation Board and other agencies for comment. They are to be returned to the task forces this week, when they will be sent to the White House. Civil Aviation Board must act on the drafts but has been reported as highly favorable.

Kodak's method of recording

If photographs had been invented during the past five years instead of way back early in the 19th century, people would be working so hard and spending so much money looking for other ways to accomplish what photography can already accomplish.

The antiquity of photography logically blinds some to its virtues. To the extent (digit, it must be admitted) that it delays its application to practical problems that it can solve today, the blindness is unfortunate though understandable.*

*We workers are not blind. We know that there are many ways of producing images. We are investigating a lot of them.



VIRTUE No. 1 is simplicity. Here is a picture of the basic amplifier used in photography.

This amplifier can provide a gain of 30. There is a gene in the bottle. We know him very well.

Some, whose imaginations were formed while working out for the Patent Office in photography, still think of swimming up the gene by retiring to a halo darkness and putting him out of his bottle into a white emulsion tray. Therefore, they think of him as absolutely wet, and this thought discourages them.

We firmly advise them that we can put the gene to work for them in any of a growing number of

techniques in which the wetness hurdle shows. It's an engineering problem, not a scientific problem. We have a goodly number of engineers who are very competent in the field and are available under suitable arrangements.



This newly announced Eastern Viermont Projector is a sample of this year's work. It does 36 feet per minute. This happens to be the rate at which film runs through a projector. The film speeds ahead one minute in the projector. It always goes to a standard commercial quality, needs no power. The machine can be shaped for situations in ships and repeated without loss of quality. We are very happy about preserving quality since we are also film makers by trade and feel a need to keep our faith in photography.

was invented too soon

VIRTUE No. 2 is information-packing density. Nothing else is ever close to photographs at the moment.

Look at this one-inch square. As you will see, if



you whip out your pocket magnifier, it is composed of the Fonda half-tone dots. You see about 16,000 dots into the same area photography could have put the same number of pixels of the Encyclopedia Britannica and recovered every character of them.

We can back off a little of this extreme information density for more light-sensitivity and pack only 16 bits of information into a square inch of film. This logic is still true for non-photographic techniques of data recording to match. Furthermore, it is not just a gene we are working toward. It is a sensible film. We have actually manufactured by the thousands of feet.



This Kodak Discolor Recorder permits a computer to introduce itself directly to microfilm. Microfilm is the proper medium for intense detail. Paper need not be, of course, only of the end of the line for summaries and conclusions. Any part of the supporting data is available for visual scrutiny, if desired. Modifications permit placing an optical reader, if desired, in a film we have actually manufactured from liquid film. 2160 points per square, very close, very dense, very repeatable, very little film from very much tape.

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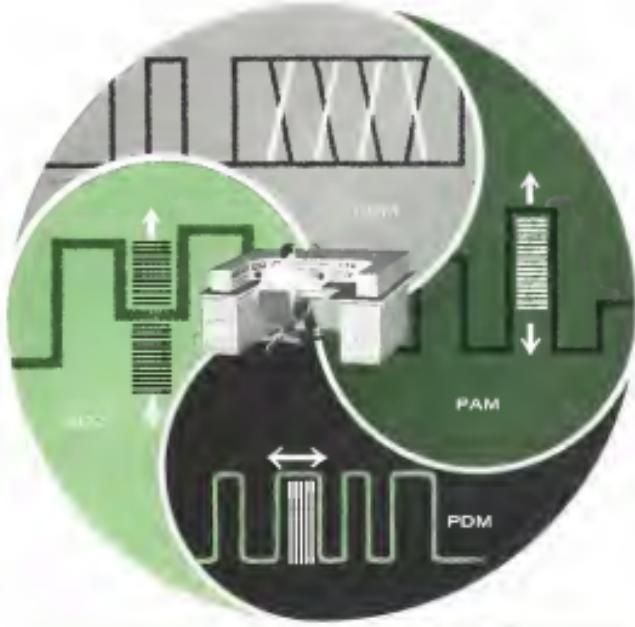
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*Extracts from the special message delivered by President Kennedy before a joint session of Congress, May 25, 1961.



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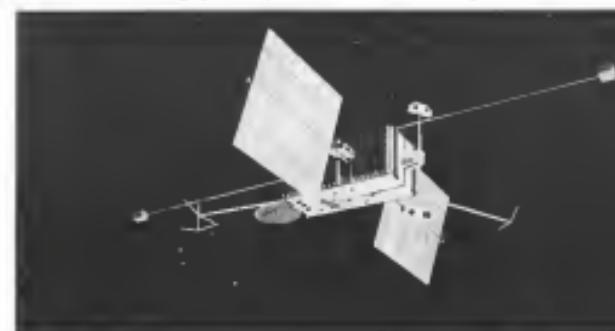
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ARTIST'S CONCEPTION of the observatory in orbit shows the three 15-lb. experimental payload packages and the hinged solar sides which can be opened or closed to control internal temperature. Solar panels on either side of the space vehicle face the sun.

'Economy' Space Observatories Designed

By Russell Hasker

Los Angeles—Orbiting Geophysical Observatories (OGOs), being designed for NASA by Space Technology Laboratories especially to study earth-oriented phenomena in space, follow current trends toward miniaturization and real purpose design.

Though NASA has ordered only four of the spacecraft to be built, STL officials are confident there will be no desire to take advantage of the low cost and wide potential of these designs, and are now preparing additional three-flight (OGO-1) and four-flight (OGO-2) versions. One of the fourth-spacecraft will be dubbed POGO (Polar Orbit Geophysical Observatory), and one will be held in reserve in case one of the other two is unsuccessful. Launched if both of the first two are successful, the backup spacecraft will be used as a second POGO.

First of the spacecraft to be launched will be OGO-1, scheduled for the spring of 1965, and will be launched from Cape Canaveral in an Atlas-Agena B launch vehicle with a 10-day orbital orbit.

The orbit is to be highly eccentric with a perigee of 150 mi. and an apogee of 60,000 mi.

POGO launch is tentatively scheduled for the fall of 1965 at the spring

of 1966. It is to be launched into a polar orbit with a perigee of 100 mi. and an apogee of 900 mi. It will be launched from Vandenberg AFB, Calif. by a Thor-Agena B rocket system.

STL officials say greatly reduced costs of the observatories could be achieved by launching in Convair's Centaur liquid-hydrogen-rockets, or in Atlas-Agena space laboratory experiment packages than those which will be aboard the rest of the OGO program. According to the source of the project, the total payload will be only in the uninstrumented carrying vehicle.

Instrument Payload

The word observatory is used for the spacecraft with all its research instruments aboard. The usual version of the spacecraft is to weigh 730 lb. The instrumentation payload for OGO and POGO is to weigh about 130 lb., giving each observatory a gross weight of about 900 lb. Centaur boosters follow-on observatories might weigh up to 1,500 lb. and might leave room for cargo back in orbit according to STL officials.

NASA specified that the spacecraft will be extremely light, and the OGO-1 system must be designed for 50% reliability after a year in orbit. OGO is intended to be within the present bounds of technology. Minimum requirements for payload and total weight are about the most ad-

vanced components that will be used. At yet NASA has not announced the list of experiments which will be put in the OGO and POGO observatories but STL has been involved in early planning of such spacecraft for 10 experiments dealing with the geomagnetic field, atmospheric composition at orbital altitudes, radiation fields, etc. Some engineers predict that the actual number of experiments will be nearer 40 because of the readiness of experimental instrumentation packages to run overnight.

At yet, STL is preparing to spend design, construction, and instrument payload costs only. Observations, power requirements, lenses, solar orientation, mounting components, as house-mounted packages, space instruments available, etc. While most of the experiments being considered for the orbiting observatories will advance and amplify the work done in the Explorer program and after early earth-oriented space programs, they may also be used for some solar studies.

An OGO spacecraft will consist of a 6 ft. x 1 ft. x 1 ft. box-shaped body, a pair of wing-like profiles at arms of 10 ft. long, and a central instrument package mounted on opposite ends of an axis through the center of the body, and a rounded nosepiece mounted on an boom.

The orientation of OGOs in space



Initial guidance activities at General Electric's Ordnance Department continue some of the most exciting and challenging work done by engineers with creative solutions. In addition, The Polaris MK 2 Guidance System design meets the Navy's stringent requirements for the kind of precision that Ordnance Department engineers and scientists can deliver.

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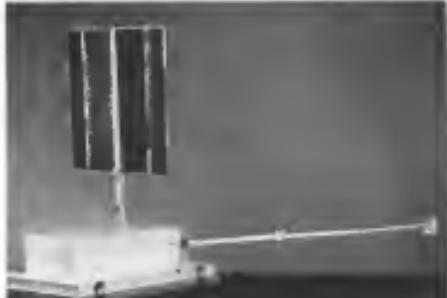
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GENERAL ELECTRIC



STL MOCKUP shows the proposed arrangement of the folding boom designed to hold an experiment package away from the rest of the instrumentation contained in the satellite.

will be controlled and 15 experiment payloads will be accommodated inside the rectangular body in addition to look around toward earth or surface into dark space. So, the one boom will be a dual purpose, through the telescope and should obviously be capable of holding both types. Instrument packages to observe the sun are to be mounted on the outer ends of the two solar cell panels because the panels will always be oriented to face the sun. The instrument package will be one presented. The only presented experiment payload in the observation will be the paddle meter and data tape. Present will be large at about 15 psi.

The NASA specification requires that each observatory accommodates eight experiments in at least two boom-mounted packages at a distance of at least 15 ft from the center of the instrument and other equipment. These will be reserved for experiments which can normally survive in zero g and mitigate interference from the other experiment packages as well as avoid this sort of interference with the other experiments. This will be to be sure after external experiment payloads mounted on 4 ft booms that this part of the design is not well defined yet. The 4 ft booms will also carry the three communications antennas. The packaging needs the main frame of the Agema B launch vehicle. The booms will be designed to fold. Teleflexing booms are not being used because of the possibility of trouble with control gear.

Missiles of opposite ends of an axle on one end of the rectangular body will be a pair of Orbital Plane Experiment Payloads (OPEP) gyrosteered to point axially or azimuthal differing up-

lets into the plane of the orbit. The two package OPEP design was selected to give the greatest possible scientific return. The density of the atmosphere near the planned perigee is great enough to produce a measurable drag force, which will tend to deorbit the vehicle if it is unsteered. STL engineers believe, reasonable, stoppage of the OPEP instruments will cut the gas consumption of the attitude control gas jet reaction rate by a factor of 10.

Program Cost

The prime contract signed in January and extended more than three years called for a program duration of about 42 months. A \$12-million development cost of the rest of the contractor at \$15 million but given program officials will the final cost be raised to between \$30 million and \$35 million. The final contract still is being negotiated. The spacecraft will be instrumented at the new STL facilities in Radcliff, Black Gold.

Information for the spacecraft attitude control system is derived from four known sources: fluid rings on the bottom of the flexible body and from air sacs on the solid cell panels. Control power is stored in the spacecraft as provided by three momentum wheels and a jet reaction system containing compressed argon through six nozzle nozzles mounted on a pair of 90° booms which extend from one end of the body. The booms will have a

Missiles of opposite ends of an axle on one end of the rectangular body will be a pair of Orbital Plane Experiment Payloads (OPEP) gyrosteered to point axially or azimuthal differing up-



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POLARIS "ON COURSE"—TIME AFTER TIME AFTER TIME

Over 40 Polaris missiles—with completely operating inertial guidance systems designed by Massachusetts Institute of Technology and produced by General Electric—have been flight tested from land, sea, and under the sea.

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Polaris Inertial Guidance is typical of the many precision products—antennas, fire control, inertial guidance, launching and handling equipment, torpedoes—being produced by General Electric's Ordnance Department.

ORDNANCE DEPARTMENT
BY THE DEFENSE ELECTRONICS DIVISION

GENERAL ELECTRIC

IN PLASTICS, AERONAUTICAL, ELECTRICAL, MECHANICAL

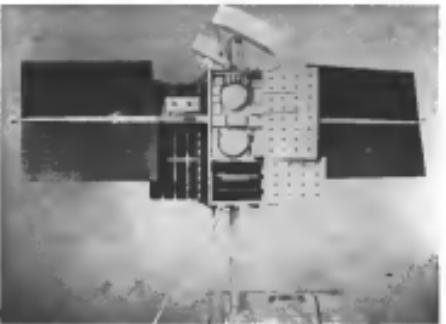
ARMA guides Air Force ATLAS in first full-range inertial flight

Cape Canaveral July 7, 1961. The Air Force announced the successful flight of an Atlas ICBM guided by the ARMA inertial system 5,000 miles into the Indian Ocean.

A giant step in missile and space technology, this important first of pit-pointing a target nearly half-way around the world demonstrated the phenomenal accuracy and reliability of ARMA inertial guidance—America's first inertial guidance system of intercontinental range accuracy. This flight was another achievement of ARMA inertial guidance which has performed successfully on

every flight since the initial test in March 1960. Today the ARMA system is in full production.

ARMA inertial guidance provides our nation's ICBM system with all the advantages inherent in inertial guidance—true fire, all-weather capability, immunity to outside interference, a maximum of costly ground equipment. Although specified for the Atlas missile, the ARMA inertial system is a completely self-contained, self-correcting navigation system is adaptable to other aerospace programs and space exploitation programs.



EARLY CONFIGURATION OF OOG down-satellite and metingal experiment modules made the last flight. Two Orbital Probe Experiment Packages are at top. The particular instrument shown at the bottom of the workshop has been replaced by a Yag instrument.

second stage at the hinge. A 15lb. supply of argon at about 2,100 ps is expected to last for one year with ample reserve. Each attitude control nozzle will develop about 0.05 lb. thrust with a flow rate of 0.001 lb. per sec.

Minimizing Wheels

Orbital attitude disturbances are to be resisted by the momentum wheel. Since the direction of a rocky disturbance is reportedly reversed when the wheel is rotated, the wheel is used without a long-term building of velocity by an exciting force in one direction, then in the opposite one. The wheel will be rotated as an effort to cancel successive, cumulative disturbances but eventually will be vibrated when they reach their maximum speed. The gas system will then be used to dampen attacks, while the wheels are stopped.

The momentum wheel is a biaxial canister for modified square only at maximum torque, and has a 180 sec. free run. It must stop with a speed, starting zero, when velocity is not needed. Total angular velocity change is controlled by varying the duration of torque. Pitch and roll momentum wheels can be tilted with respect to the earth and the sun, except in the planes of the long axis and the vertical axis. The pitch wheel will be tilted twice the sum of ratios of the other two with a torque of 0.001 lb. and a minimum angular acceleration of 6.0 sec.

The aerospace design gives the space craft the ability to tilt the solar off panels under the axis of rotation, selected by STIL engineers in little detail. The long axis of the rectangular body is the axis about which the equipment

pitched. The axis and centerline of the two solar paddles is the "roll" axis and the vertical axis of sun is perpendicular to the other two.

First

The first operation of the attitude control system after launch is the "ac quiescent sequence" during which the quiescent momentum wheel is rotated 90° with the canister and the axis of attitude reference. With the paddles parallel to the pitch axis the attitude control system first moves the space craft to pitch end-over-end, with the paddles are perpendicular to the plane of the sun.

Second

The paddles are turned in face down at the sun and the rest of the quiescent is rolled until the long axis of the body is parallel to the sun. Quiescent, the pitch control is thus shifted to the earthkeeping system and another pitch controller is exercised to set the four horizon sensors to zero. The roll sensor, while the paddles rotate to sun face, will be set to zero. The three line out sensors are integrators for orientation. The pitch is redundant to gas switches.

Third

Quiescent for roll momentum is then shifted to the earth sensors and the quiescent is initiated so that the long axis of the body is horizontal with respect to the earth and the sun sensors in the planes of the long body axis and the vertical axis. The paddles remain tilted at the sun. The orientation is then complete and the earth sensors take over the responsibility for pitch and roll while the sun sensor controls yaw and pitch. Sun sensors may be photoelectric cells or infrared detectors.

As the geopotential observers make an orbit around the earth, it passes or

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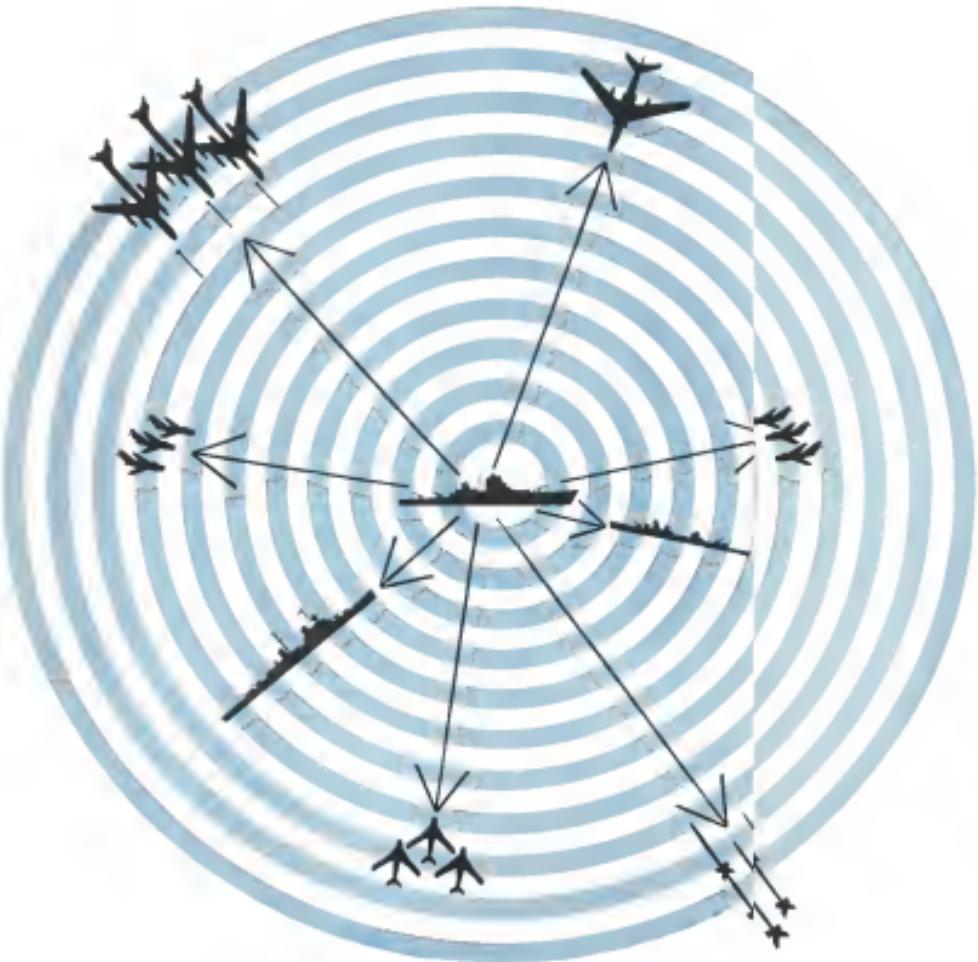
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Westinghouse contributions to TYPHON are the result of many years of experience with such basic elements as radar, computers, airborne surfaces and control, and search and tracking systems.

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axis to keep the main axle facing the earth with an accuracy of within two degrees while swiveling and rotating its paddles to keep them turned on the sun. The angular rate of motion of the inverted spacecraft must be held to less than one revolution per second. To avoid using unreliable slip ring or switch contacts between the solar cells in the paddles and the internal electronics, two sets of the profiles of the STL, biplane paddle rotators in 100 day and end single endolever swivel. Since the earth-pushing vehicle could not be left free to rotate at one revolution per second, STL sensitivity worked as a "maneuver controller" to keep the profiles from sending up the power system warning.

The sun turn is a 180deg. turn which reverses the direction of the slew, earth rotation is roll and pitch as that is caused by the turning. The rotation is made possible by offset on opposite sides of the earth. Since the sun turn is cyclic, the maneuvering hand action can be used to turn the vehicle back to the orientation. It is for this maneuver that the yaw wheel is to be made larger than the pitch and roll wheels.

Non-cyclic changes in disturbances are the separate, separate, acceleration, undulations, deflections, 40 type errors from the booster system, solar radiation pressure, etc. Except for the acquisition, these are tiny small factors or never beat since is the cause of the errors.

The rate gyro to control the rotation of the OPLF packages also will be used by the attitude control in roll and control during the sun turn. While the rate gyro is necessary to control roll to be held, the attitude control will allow for a accurate rotation. The addition of a rate control enables the sun turn to be made with more efficiency. The rate gyro will also make the sun turn more rapid. The attitude control system will still make the sun turn more rapid, but the spacecraft will need to front load the proper attitude and will waste power to hold high rotation rates.

STL engineers are considering in addition of a rate gyro in the pitch system to prevent the spacecraft from descending into the atmosphere in the earth's wing plane of motion. Other changes in the pitch plane also are being studied.

Since the bus is oriented to hold the sun in the plane of its long axis and the vertical axis the vertical sides of the bus will never absorb heat after from the sun or from the earth. STL designers are taking advantage of the arrangement in the design of the temperature control system. The solar facing cold space will be covered with thermal which can be opened or closed to control the rate at which heat from the unshielded power system is radiated. When the sun is delayed by the earth,



Israeli Rocket Stirs Controversy

First rocket launched by Israel on July 5 produced a massive smoke cloud at an altitude of 30 km and set off a political controversy involving Israel, the United Arab Republic and the U.S. Israel, which had the subsidized rocket in secret, first and it was for research purposes only, but Deputy Minister of Defense Shimon Peres later said the program had priority because of "grave defense problems." The UAR then asserted that it was negotiating with U.S. firms for research markets because National Aerospace and Space Administration had said it could not supply them on short notice. U.S. State Department has denied the claims in living system. One consequence, however, was that State denied an export license for their purchase, but congressional pressure forced State to issue a license. The UAR's Israeli rocket, called Shavit III, which means Comet II, was developed with the help of a Princeton nuclear scientist in the United States. Rocket is a missile refined with funds received from the Lockheed-NASA missile market.

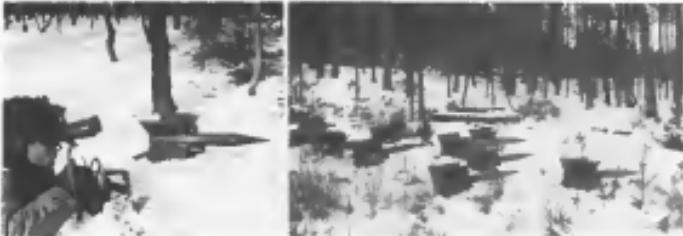
The Soviets will be forced to return the power system heat and will be exposed again to the intense energies in the direct light of the sun.

Appropriately 10 kg of photo voltaic cells in the paddles will generate 100 watts of power. Experiments are to use an average of 50 watts each and use not to exceed a total of 50 watts. The power system will provide average level power in each experiment. According to specification each experiment will yield 28 watts plus or minus 10% ± 5% of the experiment which need more power regulation must have their own regulation. One advantage of this is that the failure of one regulator cannot shut down the entire system.

The spacecraft will be equipped with a stable oscillator clock that will be accurate to one part in 100,000. The clock will provide time for the position of experiments and can be used not in Greenwich Mean Time. Both forced vibrations will cause mag monomer for magnetism of the geostationary field. There is also a good likelihood that they will carry some spectrometer capable of identifying atmospheric constituents up to an atomic weight of 90.

Our industry transmitter will handle 60,000 bits per second. There will be a 64 bit per second system so that Motorola, without one real test data from the observatory. The magnetometer experiment will have a separate telemetry channel to send direct modulation analog output.

MISSILE ENGINEERING



BATTERY OF EIGHT Cobras were guided anti-tank missiles can be launched and controlled in a single subsystem. In another situation (right) would be more widely dispersed. Controller (left) follows flight of the missile through binoculars mounted on control box. Control stick in the right-hand gunner's console to target.

Bölkow Pushes Cobra as NATO Missile

By Carl Bransford

Munich-Bölkow Entwicklung, a wholly owned subsidiary of Messerschmitt-Bölkow-Blohm, has been an import rather than an exporter as it continued the technical quest necessary to close the technology and launch caused by the 10 years of forced march it followed World War II and the Treaty of Versailles.

It also failed to sell the way to the U.S. armed forces and, before the situation are still good despite a recent Army order for Thun's lessons Naval SS 11. One new feature which Bölkow believes will add to the Cobras' strategic value just as a folding fin version now under development for cover transport in a smaller package was difficult and for design was terrible.

West German Order

The single-seat, two-seat Cobras, with a maximum effective range of approximately 1,750 m, have been ordered in quantity. In the West German Defense Ministry, and is now being evaluated by the armed forces of Italy and The Netherlands.

If accepted by one or more of the NATO nations within Europe, Bölkow probably will gain licensed production rights to firms within the individual countries involved. The same would hold true for the U.S. orders. Bölkow already is marketing the missile to countries in West Germany, with ten representatives and has signed a firm agreement for U.S. production of the Cobras by Bölkow Inc.

Sales to other European nations and to the U.S. would represent a major milestone in the reconstruction of the

West German industry which, since 1945, has been an import rather than an exporter as it continued the technical quest necessary to close the technology and launch caused by the 10 years of forced march it followed World War II and the Treaty of Versailles.

Production Prototype

First production prototype of the project No. 510 Cobras was built in 1959 with the intent of providing the West German army with an all-electric lightweight anti-tank missile system that could be carried along with its support equipment in an infrastructure.

Weighting a total of 22 lbs and 35 lbs with launch rail in place, the Cobras has a high ballistic ratio 7.5:100 and combined. These sets wings located at the rear of the fins and that would normally be mounted on the side of plane. Only central housing located the hollow charge warhead. The aluminum warhead casing which endures a 3.5 lb. blank powder charge weighs 2.2 lbs for a 7.5:1 ratio.

Carrying handle is located between the two upper wings. Behind that are the fins, plus a flat metal to facilitate identification and reading as the operator guides the missile towards its target.

Internally, the Cobras has a 12,000 rpm gear assembly for rifling stability mounted directly behind the warhead afterburning ring which turns some Cobras components, persons fold charges and other components to store.

Behind the gun is the solid-propellant control rocket motor and a speed of 1,000 ft/sec containing 1,970 yards of

thin guidance cable composed primarily of alternating silk and copper strands. Original design called for a steel cable, but tests showed it tended to snap during abrupt maneuvering and the copper/silk combination was adopted after a number of trials. If possible, the missile would like to adopt a plastic cable, but no discussions have been found thus far in which the off comes has not been reported to cause electrostatic problems.

Rest of the fuselage is protected by a waterproof removable lid containing 6.6 ft. of launching cable which can extend to an angular pitch before being and provides the electrical impulse that initiates the solid-propellant booster unit.

Warrior Location

The booster unit is located beneath the fuselage. Across the rear lower wings with its nozzle control dimensions of 2.25 x 10.50 to provide the necessary 3.5:100 ratio.

The operator, who requires approximately 20 hr. of training for his task, monitors the Cobras flight from a portable 7.2-kw control containing a "joystick" for elevation and directional control, a selector switch that enables him to launch in more than eight minutes in successive, a firing switch and a pair of binoculars for observation. The unit without binoculars is 6.4 in wide 9 in long and 5.5 in high.

Launch comes from the minimum of eight missiles, one operator can handle the system and to a certain extent can fire two types of charges to another.

In operation, the Cobras approaches

the target at a speed of 279 kps., or approximately 190 mph. Five successive launches by an individual operator with six missiles on hand depends largely upon the length of flight of each unit. About 35 sec. is required for a maximum range flight of 1,750 yards.

For the first, 100 ft. of its horizontal trajectory, the Cobras flies on its own. Because of the speed of the missile and the possibility of human error before the missile has gained sufficient altitude for operator action to be taken. The initial 100 ft. is covered in approximately 1 sec., with the missile going 10 to 15 ft. altitude during this time. Attitude-error limit builds up to the point where the operator has full deviation and directional control after the Cobras has covered about 160 ft. from the launch site.

Booster unit burns for a total of 1.6 sec., and then the sustainer can be for another 1.6 to 20 sec. or even the Cobras to its target. An electronic switch located in the rear of the warhead prohibits the launcher from operating until after the booster unit is burning.

Through its binoculars, the operator smoothly guides the missile to the target using electrical impulses transmitted by his control stick system. Reference point in the tracking ring during day time launches or the glass of the launcher exhaust at night. In an area where a number of Cobras units have been deployed, each operator is to receive a specific filter code to minimize the confusion if several missiles

should be in the air at the same time. After the initial uncontrolled boost to altitude, the operator normally brings the Cobras down again to within a few feet of the ground and then, finally, onto a direct hit with the target. The eight profit can score, however, and score can be automatically to be over or below the target. Hit and miss ratio to achieve a missing limit, whose mean speed would be about 15 mph.

Overall, the missile has a total weight of 70 drag and can make a full curve after traveling a total distance of about 3,300 ft.

German army regulations prescribe that the Cobras be on fire with the target for at least the last 10 sec. of flight whenever possible. Thus, of course, cannot be done at the missile's maximum effective range of 1,700 ft. which it could occur in just under the seconds if an evader action is required, and Bölkow officials say it is important.

The Cobras warhead has a penetration force on the nose tip and a detonator at the base of the hollow charge which, as a safety provision, is activated by an automatic timer bar and one-half seconds after firing. The timer is set into motion by the acceleration forces at launch. As an added protection, there can be no detonation on impact with the ground, only when the warhead strikes an object with the resulting impact of heavy metal.

In Bölkow tests, the warhead has penetrated steel armor plate up to 24 in. in thickness, the equivalent of

Bölkow Expands Research and Production Capabilities

Munich-Bölkow Entwicklung K.G., which got its birth as the design and manufacture of planes after its formation in 1955, is developing into a major research and production arm of the West German military and industry.

Founded by Dr. Ludwig Bölkow, who formerly had been associated with Messerschmitt for a number of years, the company's scope of interest now includes guided and lightplane aircraft and the tools, and tank missile systems and aircraft in the center and research centers space and aircraft research on the far east. Present projects include:

• Bölkow 204 four-place low-wing lightplane powered by a 110-kw. GM Lycoming engine. Although the first production models are just beginning to appear, Bölkow has over 10 orders on hand, and is currently in the delivery of 10 aircraft per month. The 204 with a maximum speed of 127 mph, with an approximately 511,700 m. Circumference.

• Bölkow 105 all-metal two-seat aircraft with a cruising speed of 125 kts. Manufacturing rights for the plane were recently purchased from a Swedish firm, Miles Flight Industry. Production will begin later this year. First prototype of the plane was built in the U.S. under the designation Bölkow 105 by designer Björn Andreasson, a Swedish citizen working for Convair at the time. Projected German selling price is about \$6,000.

• Bölkow 202 Helitank, essentially a single-seat single-engine helicopter mounted on a revolving ground support. Helitank, designed to give the student the basic and feel of flying a helicopter while tethered firmly to the ground, has been

any known to be in the forces Soviet tanks.

The 16-ft. polystyrene plastic storage and carrying case for the Cobras is divided into four sections that are fixed when two quick release metal straps are unfastened. Winch and control rods are carried in separate sections of the case. The two sections of the control structure can be folded around or other bodies of water during tactical exercises.

A plastic bag housed in the case contains 65 ft. of control cable for connecting the Cobras to the launcher box when the missile is placed in a suspended position as well as a small launching plate.

Use of the plate is optional and designed to ensure minimum booster thrust and to minimize the amount of debris and dirt created at launch.

In the field, an infantryman can carry a loaded launcher on each hand, with the control unit, 26.5 lb. in weight and the missile is placed in a suspended position as well as a small launching plate.

The Cobras warhead has a penetration force on the nose tip and a detonator at the base of the hollow charge which, as a safety provision, is activated by an automatic timer bar and one-half seconds after firing. The timer is set into motion by the acceleration forces at launch. As an added protection, there can be no detonation on impact with the ground, only when the warhead strikes an object with the resulting impact of heavy metal.

In Bölkow tests, the warhead has penetrated steel armor plate up to 24 in. in thickness, the equivalent of

what an American, Spain, France and Sweden have built for the job.

• High-speed anti-aircraft with a small approach towards eliminating hypersonic jet speeds. Company now is building a small piston-engined helicopter to match with the same system for flight evaluation tools.

• Extensive work on an advanced defense system to replace its lightplane Cobras anti-tank missile designed for infantry use.

• Model research that has led to the development of a solid-propellant high altitude rocket with a range altitude of 50,000 ft. Rocket is now in the research stage.

• Space research largely concerned expand payload capabilities. Under West German government direction, Bölkow probably will play a major role in the future European space program.

• Whelkord detection techniques for missile and aircraft anti-aircraft systems. Work probably enables users to find sources of detecting low-flying ships that cannot be picked up by conventional radar.

Hq'dquartered in the Munich suburb of Ottobrunn and with a growing number of subsidiary plants, Bölkow also is a partner with Messerschmitt and East German Fliegentechnik in one of West Germany's top-priority projects—development of a high performance aircraft as an entry into the North Atlantic Treaty Organization competition for a VSTOL short-takeoff and landing aircraft now under way.

ENGINEERING
REPORT
ON RENDIX COMPONENTS

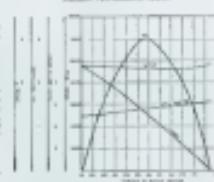


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Available for immediate delivery, these miniaturized Rendix® motors (Type number CK 1066-16-AL) are designed for applications where space and weight requirements are at a minimum. So small that four can be packaged in a square inch, these motors are ideally suited for missile instrumentation and similar miniaturized applications. The motor has a tapered shaft; however, units may be obtained with other type shafts and with center tapped control windings.

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Fairchild Aircraft and Space Products, Inc.—Seattle, Wash.; Boston, Calif.; and Philadelphia, Pa.;
Fairchild Space & Service, Fairchild International, 200 E. 42nd St., New York 17, N.Y.

that can be moved to the right or left. Cola and his potential as a light weight defensive weapon for the colonists already has been studied in U.S. Marine Corps officials and by representatives of the Seventh U.S. Army headquartered in Germany. The missile also has been fired on at least one occasion for the Army within the U.S.

In the Seventh Army tests, Bellows' Ernst Wittmann, one of the chief developers of the system, worked for three days with a team of test-flight crews who then proceeded to complete a score of test flights in 20° left wing loading. Tests for the system were done using dynamic systems including rotating rings, as well as aluminum vehicles.

In an new U.S. evaluation, the German team will make available the data compiled during its extensive tests of the system prior to the decision to order the Cola in quantity.

Bellows also is seeking to follow-on designs for the Cola under German government sponsorship—of an 800-mm. gunpowder and liquid-fueled personnel, roughly 200 kg. are employed in this field. Both include lighter weight gunpowder and possible automatic guidance.

With present techniques, however, gunpowder imposes weight and logistic problems plus performance disadvantages. A liquid control unit is required to control the launch and a liquid gunpowder would be needed to provide one for attitude and one for three axis.

Such a system would restrict the maximum angle of turn to about 20 deg. according to present Bellows studies. A possible compromise could be a solid combustion with solidifying gunpowder, as well as a single gunpowder or solid gunpowder in order to provide the mobility of the current system and maintain the maximum turn of maneuverability.

Barber idea for the present Cola began to receive interest after World War II and in 1956, just long after the organization of Dr. Bellows' Bellows, Barber signed a development and production contract with the German industrial firm, Contraves and Dornier.

"At the time," one official said, "German had nothing. We needed the Swiss to make the powder for the rocket motors and for the warheads. Dornier also did development work on the gunpowder system. It was from this association that the Cola originally received its abbreviated name—Cola, Dornier, Bellows, Rendix (rocket).

In 1958, with West Germany, a member of NATO and Switzerland, the agreement was terminated. All subsequent rights and developments belong exclusively to Bellows, according to the West German firm.



Army Tests Redhead/Roadrunner Target Missile

This photo of an actual Redhead/Roadrunner target missile shows a 6000-lb. thrust液体 rocket engine lifting the Army North American AT-35 vehicle from its launcher at White Sands Missile Range, N. M., in its first successful test flight. After the booster was detached, the missile mounted Thor-Mark liquid engine completed the 19-ft long target missile at supersonic speed on a relatively low-altitude flight. Recovery was made with no instrument problems. Redhead/Roadrunner is designed to fly at altitudes from 300 ft. to 50,000 ft. Launching was performed by an Army North American crew (AW 17, p. 99). Previous attempts to test the missile were unsuccessful.

Vigilant Sales Pushed Despite Cost

London—Vickers Armstrong is continuing an international campaign to sell its Vickers Vigilant anti-aircraft missile to Western nations, despite a British Ministry of Supply ban on the export of anti-aircraft missiles.

Vickers executives believe the Vigilant exports will be the best that can be had. The Vigilant is a supersonic anti-aircraft missile with a 1000-ft. range, a 1000-ft. altitude, a 1000-ft. range on the ground, and a 1000-ft. range on the air. It has a solid propellant motor and a liquid oxygen oxidizer. The Vigilant is a solid-state missile with no moving parts, and it is the only weapon of its type to include a gun sight for high control at its range, which is twice the range of the current British gun sight.

The Vigilant is a solid missile, as well as a solid gun sight. The gun sight can only be used in the air. On the ground, the gun sight is not used, but the Vigilant was built which Vickers said was the first in more than 1000 flights. Col. H. L. Laver, of the BAC Guided Weapons Department, said a Vigilant operator can learn to shoot a gun sight in 10 minutes, and to practice shots. Actual training should need no more than two or three Vigilants per year, he claimed. The flight program has had a total of 100 flights, and 1000 flights and up to 200 Vigilants.

For follow-on, the Vigilant is being developed as a heavier-missile system and will be used on a fighter aircraft, which could load two Vigilants at a wide range of positions. Current research is on extending the Vigilant's range and on increasing the range of warheads.



AUTOSYN' SYNCHROS
Synchros for maintaining control velocity



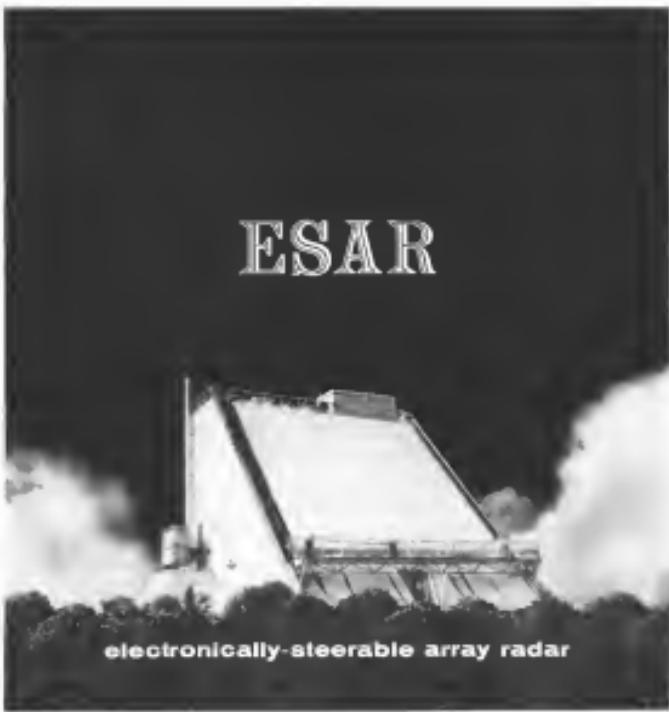
These Rendix size 2 Autosyn synchros are well suited to the needs of missile instrumentation and similar applications requiring synchronization of two or more rotatable elements. Typical characteristics are listed below. For additional information, including dimensions, weights, materials, and differential characteristics, write today.

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Autosyn	2	1000	1000	1000
Autosyn	2	1000	1000	1000
Autosyn	2	1000	1000	1000
Autosyn	2	1000	1000	1000

Operating temperature range: -10°C to +70°C.
Max. ambient temperature: 50°C.
Max. altitude: 10,000 ft.
Max. current: 1000 mA.
Autosyn is insensitive, neutral, and differential.

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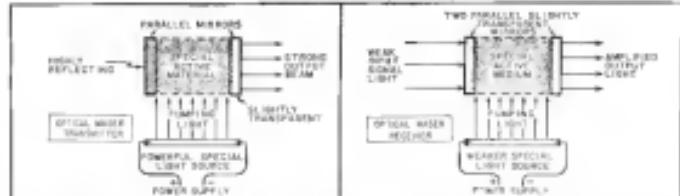


An experimental model ESAR radar which demonstrates the fundamental aspects of electronically-steerable array radar is now undergoing test at Bendix Radio. The successful culmination of this experimental effort could provide the basis for a new technology leading to the development of multiple function, electronically steerable array radar capable of searching, tracking, deep space communications and command control. ESAR is part of Project DEFENDER, the program of advanced research in ballistic missile defense directed by the Advanced Research Projects Agency, Department of Defense. The ESAR contract is administered by the Radio Art Development Center of the U.S. Air Force. Organizations working on advanced space concepts are invited to contact Bendix Radio for details, and to see ESAR in operation.

Bendix Radio Division
GOVERNMENT DIVISION, BETHESDA, MARYLAND



AVIONICS



OPTICAL MASER facet holds many advantages for space vehicles, integration ease with the development of a laser receiver expected soon. The receiver light will function with laser transmitter (left) which already has been demonstrated. Receiver enables transmitter concept that pumping light source is weaker and second source is partially transparent to allow signal from donor transmitter.

Laser Challenges Radar for Space Use

By Philip J. Klass

WILMINGTON, NC — An optical laser radar sensor, with unusual characteristics that will make it extremely useful for space vehicle navigation, can be expected as the next future perhaps within several months. Dr. Cecil B. Ellis of General Precision, Inc. predicted here during the recent annual meeting of the Institute of Navigation. The report was reprinted in *Space & Ground*.

The optical laser receiver, which is similar to optical radar transmitters that already has been demonstrated by several researchers (AW, July 18, 1969, p. 36), should provide a system which can measure distance (range) and velocity with far greater accuracy than is possible with radar.

Equally important for space vehicles, the optical receiver system is expected to be considerably smaller, lighter and less complex than radar, and to consume less electric power. (For a description of experimental laser radar developed by Hughes Aircraft see AW Feb. 27, p. 61.)

In principle, the optical receiver system is expected to receive directly from the laser transmitter. Ellis said, in the laser transmitter, a suitable wave field, laser or gaseous, is placed between two parallel mirrors and excited from a special light source called "pump," which readily surrounds the active material.

Energy from the pumping light excites atoms in the active material, causing them to emit light which is reflected back and forth between the two mirrors, where it is reinforced. This light in turn stimulates other atoms to emit light which is in phase (coherent) with the existing light and

thereby greatly increases its intensity. If one of the two mirrors is slightly divergent, the light will pass through and emerge as an intense beam of relatively small width. This extremely narrow beam width, which Ellis predicts will be reduced to only 62° of a second of arc within a year, is one of the extremely useful characteristics of the device. Another is the fact that as bandwidth the it is extremely narrow. Low-power devices built to date have exhibited a frequency spread of only a few parts in 10¹⁰, and it appears that a spread of only one part in 10⁹ or 10⁸ can be achieved ultimately, Ellis said.

Laser Receiver

In a laser receiver, both mirrors would be optically rotated. This will permit passage of internally generated light from one mirror, as well as the transmitter and also will permit external light from a separate laser transmitter to enter through the other mirror. Additionally, the intensity of the pumping light source would be reduced to just below the point where threshold conditions (laser action) begin.

Under such conditions, when light from a separate laser transmitter enters the laser transmitter and passes on outwards, part of it (60%)

will extremely useful properties. • Frequency (wavelength) of the incoming laser transmitter beam must match precisely the resonant frequency of the receiver, which is determined by the choice of active material used and the physical spacing between the two mirrors.

• Direction of the incoming laser beam must be precisely aligned with the optical axis of the mirror. Otherwise the incoming beam will be reflected out of the mirror before it has made sufficient distance between the two mirrors. This means that a laser receiver will amplify only that fraction of any light beams falling on it which is very closely parallel to its axis, within a divergence angle which corresponds to the divergence angle of the beam emitted from a transmitter of similar design.

These inherent characteristics mean that a laser receiver is much easier to distinguish between a desired signal and unwanted background light. This is well illustrated for example, a laser receiver can operate as bright sunlight and amplify a laser beam from a separate laser transmitter which enters its receiver and while partially ignoring the extremely bright light.

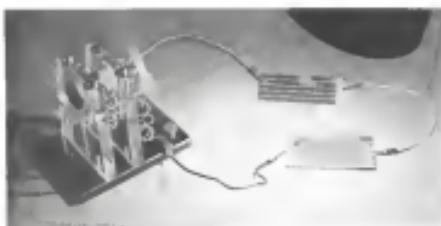
Even if a weaker laser at present drowns out the sun, it will not be receiving much amplifiable energy since it can only accept a bandwidth which is a millionth of the visible spectrum, and a solid angle which is a hundred millionth of the sun's disk at sun distance from the earth, Ellis said.

The laser receiver also has the advantage of not being subject to thermal noise as is most microwave equipment because materials of normal temperature do not produce significant light in the visible part of the spectrum, Ellis

process. When a beam and its reflected wave interfere, they cancel each other out. If the light falls within the size, narrow bandwidth and bandwidths of the device, it is amplified further by three-fold emission in total.

The extremely narrow bandwidth of the laser transmitter which can be fastened onto a moving vehicle, a solid-state laser should enable a laser receiver to receive very strong signals with extremely low noise. In this case, the beam is shielded and a large portion of its energy therefore will be reflected from a solid object or a long, thin, or curved surface.

Until then, in EEL and his company of General Precision (GP), Houston indicates that a laser capable of measuring distances from one space vehicle to another with which it wants to rendezvous should be able to measure this distance with an error of no more than one inch, when the two vehicles are 100,000 km apart. By setting the target vehicle to a distance of 20 ft, the laser error would expand an average beam pattern of only 40 cm. Complete laser radar system power consumption should not exceed 100 W with a 100% duty cycle. This figure is based on a target object with 100% power consumption and is based on a realistic 10% efficiency for the laser itself. EEL said.



Horseshow Develops Thin-Film Solar Cells

California Institute of Technology developed by Horseshow Chemical Co. claim sufficient power for a small satellite to drive to a propeller when cells are discounted. Horseshow is one of a number of organizations conducting research on thin-film cells which give promise of reduced cost per watt and might permit of solar cells and offering possibility of producing them in millions of space vehicles.

When a laser radar is used to measure an object, which orbits about the surface of a planet or landing gear, the narrow bandwidth offers another advantage since planet terrain is known to move. The narrow-beam laser will receive a signal amplitude over 100 times greater than an average altitude over a large area with relatively broad-beamed radar.

The laser also appears suitable for measuring relative velocity by means of doppler shift of the reflected signal. At a relative velocity of 3000 ft/s between a space vehicle and a planet, the doppler shift from the terrestrial laser beam will be one part in 100,000. This is many times the bandwidth of the returned signal which makes it conceivable to measure the doppler

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AVIATION WEEK, July 26, 1981

(source: Headquarters Bureau, B-70 Valkyrie—the largest in the world.



Mach 3 Technology

Torturing aircraft structures with the world's largest "gramaphone"

To pre-determine in flight stresses on an aircraft as advanced as the Air Force's Mach 3 B-70 Valkyrie, it was necessary to make sweeping advances in the state-of-the-art testing procedures.

One way the Los Angeles Division of North American Aviation met this challenge was to build the largest, fastest rotational test chamber in the world. Here, a massive 37 foot by 30 foot concrete testbedperches over blast aircraft structural specimens with up to 170 degrees of noise. This is the equivalent of 50,000 firecrackers going off simultaneously, yet vibration-proofing keeps this noise to no more than a distant whisper outside the lab. The noise inside the lab is so great that the heat generated could ignite fiber glass insulation material.

Specimens up to 6 feet by 25 feet can be tested in the acoustical lab. It has the capacity for progressive wave as well as reverberant sound fields, ground or aeroelastic incidence specimen orientation, discrete frequency or random noise at sound levels up to 170 db, thermal environment testing from -100°F to +1200°F, low frequencies of 50 to 10,000 cycles per second. This is indeed a remarkable facility for acoustical testing, fatigue testing, and vibration testing.

This giant acoustical laboratory can not only carry out testing on tomorrow's Mach 3 aircraft, but can perform tests on aerospace craft still far from reality. The lab is only one of the many that the Los Angeles Division has developed to conquer problems of space age flight.

Borders of the B-70 Valkyrie

THE LOS ANGELES DIVISION OF NORTH AMERICAN AVIATION



New RCA Space Environment Facility Brings Outer Space Down to Earth...



...With potent testing generation of U.S. space vehicles and satellites at environmental extremes, assuring reliable long-life operation and optimum performance.

Included in the new environmental equipment and facilities being built and installed at the RCA Astro Electronics Division in Princeton, N.J., are the following advanced testing devices:

Yankee-Thermal Chamber—measuring 25 feet in diameter and 21 feet high to accommodate the testing generation of space vehicles and satellites and meet all vacuum-thermal requirements.

Yankee-Shear System—provides 28,000 pounds peak force for sinusoidal and 20,000-pound rms force for random motion testing.

Temperature-Humidity Chamber—so versatile it can

create virtually any thermal-humidity condition desired. Temperatures may be varied from -327° F. to 130° F., humidity from 0 to 100 percent.

Rotary Accelerator—subject aerospace systems of space vehicles and satellites to forces as high as 2000 g's/in.

The entire RCA Space Center, which contributed to the success of projects such as SCORE, TIROS I, TIROS II and ECHO I, continues to be dedicated to the conception, development and production of both advanced space vehicles and ground support and information handling requirements. For additional information about RCA's engineering talents and proved capabilities, contact the Manager, Marketing, RCA Space Center, Box 80, Princeton, N.J. And, for a complete description of the new environmental facilities, write for your copy of the brochure "RCA Space Environment Center."



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shift and therefore the vehicle's velocity.

In a doppler laser system, it is only necessary to detect the minor change in an instant frequency as much as one part in 100,000 away from the transmitter's natural frequency, Ellis said. A variety of methods of altering the instant frequency appear feasible, he added. One of the easiest might be to use a small space between the ends of the rotating antenna and one of the two mirrors, which would be filled with an inert gas whose pressure could be externally controlled.

Velocity Altered

By changing the density of the gas, the velocity of the light rays passing through the gas is altered, which in turn will change the frequency (wavelength) of incoming transmitter beam light to which the source will respond. By varying the pressure of the gas through a suitable range, the transmission frequency of the laser source could be measured through the expected range of the doppler shift with sterilized certain accuracy. The gas containing the gas pressure could be exhausted directly in terms of velocity.

For optical means where active materials cannot be polarized by a frequency differing by as much as one part in 100,000, another approach could be used, Ellis said. A small electromagnet could be placed near the material to alter its natural frequency, using a principle known as the Zeeman Effect.

A doppler laser system, capable of measuring both the magnitude and direction of a laser source's velocity relative to the source at an altitude of about 3,000 m above its surface, to an accuracy of 0.1%, would require an average beam power of only 40 milliwatts, measuring measurements could take only eight seconds, according to Ellis.

More frequent and/or more accurate measurements would require higher beam power.

A doppler laser system of this type should weigh about 10 lb and occupy about one cubic foot, Ellis estimated.

Lesser-Radius Compton

Ells gave the following generalized comparison between optical meter and microwave doppler systems, assuming the microwave system uses the same diameter antenna as the meter output beam:

• If the distant object is large enough to fill the beam of both systems, in when removing velocities against the surface of the moon or of a nearby planet, the 4-decibel doppler signal can be obtained for approximately the same amount of transmitter beam

power in both types of systems. However, the accuracy of velocity measurement is usually better for the laser system whenever vehicle velocity is not exactly perpendicular to the referring source, as for a laser or planetary landing, because of the relatively large area covered by the reference beam which produces a large spread of doppler shift frequencies.

• If the distant object is small, but it can be located by optical or other means to fit in within the laser optical axis to the object, the power advantage above favors the laser, and the accuracy is also directly with the distance of the object. Even if a laser landing vehicle could carry a 600-watt Doppler radar instead, a laser doppler system with only a two-foot source should provide velocity measurement accuracy which is 2,000 times better, Ellis concluded.

almost Invisibly...



trouble grows in tired metal

The enlarged piston sector at the right has a fatigue crack. It is almost invisible to the naked eye, even though an inch of piston has been used to make crack easy to see. If the engine doesn't spot this crack at overhauled, it will grow and become as dangerous as the one in the piston at the left.

More frequent and/or more accurate measurements would require higher beam power.

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testing methods, followed with a binocular microscope of the critical areas, (2) Zygo inspection. We have some of the most extensive black light inspection facilities in the East.

You can't afford less than the best available inspection of your engine at overhauled. That is one more reason why an Airwork overhaul is good insurance of reliable performance.

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...key to life

Water means power... water means the life of the marine nation. Still... man is ignorant of the mysteries of the oceans... he is only beginning to touch the depths.

General Motors Defense Systems Division is already involved in all these phenomena. For example, new nuclear submarines and their arrays of ballistic missiles constitute one of America's most effective deterrents against attack. Water—and the control of water—is vital to national defense.

Scientists and engineers in the laboratories of the Defense Systems Division are also hard at work in land, air, space, astrophysics, biological sciences,

Water means power

geography, mechanics, and basic research projects. DSD is dedicated to serving the Defense Department and other government agencies, in cooperation with more than 1000 branches of industry and scientific groups in fields of fundamental research and engineering through the coordination of knowledge, skill, ability, and hard work.

General Motors is proud to contribute, through the growing Defense Systems Division, to the strength of America and human progress. Talented scientists and engineers in all of these specialized fields will find new opportunities and challenging assignments as this fast-growing organization.

DEFENSE SYSTEMS DIVISION, GENERAL MOTORS CORPORATION, WARREN, MICHIGAN AND SANTA BARBARA, CALIFORNIA

Lightweight, Compact Atomic Clock Built

By Barry Miller

TECHNOLOGY. **COLD**—Usually, light-weight, compact rubidium frequency standard, or atomic clock, which can have wide uses where competitive designs are too bulky, too expensive has been developed and is being evaluated by Clauer Technology Corp. here.

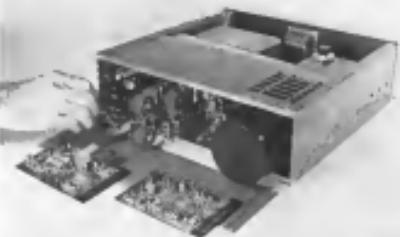
The evaluation standard is one of a broad class of devices which utilize the atomic resonance phenomena in a gas to cause it to provide an accurate and stable output frequency or time standard.

Developed for laboratory and field use, the Clauer standard weighs 30 lb, occupies approximately 3 cu ft, and draws 40 watts during normal, 20 watts during normal operation. The company is offering it for \$4,000 in single-unit units. An optional version of this rubidium standard could be packaged in less than 1 cu ft, according to Dr. Milt Fox, Clauer president, of the company.

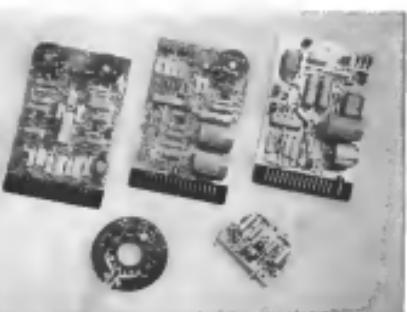
The device is capable of providing outputs to an accuracy of 1 part in 10¹⁰ (which is defined as the degree to which the output frequency is equivalent to an accepted standard). Stability—a measure of how well the device maintains its characteristics 2 parts in 10⁹ (long term) and better than 5 parts in 10⁹ (short term), the company says. Short-term stability is calculated on the basis of a series of readings taken at one-second intervals and averaged over a period of about 10 sec.

Highly accurate frequency standards perform key functions in a variety of aerospace applications. These include synchronization of communications networks, timing for scientific and space probe tracking stations, celestial frequency standards, scientific laboratories, timing or electronic communications, and timing and synchronization for navigation and guidance systems.

While essentially similar to other rubidium frequency standards in its general mode of operation, the Clauer device incorporates a number of engineering modifications which reduce the bulk and complexity of the device, and, consequently, reduce the dimensions as well as weight of the unit. It is thus standard, as in smaller ones, the output frequency of a crystal oscillator selected at some submultiple of the required frequency of a rubidium gas, in which plaid and applied as excitation to a microwave oven in which the gas is contained. Resonance is enhanced by the optical radiation from a partial outer coated discharge lamp. The amount of optical radiation absorbed in the gas is a function of the relative ab-



COMPACT rubidium frequency standard developed by Clauer Technology Corp., occupies approximately one cubic foot, weighs 30 lb, and is designed for laboratory and field use. Black rectangular package of right contains microwave cavity, rubidium gas cell, microwave lamp, photodiodes and photogate.



TYPICAL circuit boards used in rubidium frequency standard. Circular boards are employed in cylindrical optical microwave and microwave cavity and gas cell.

sorption of microwave energy. Hence, provides a measure of the departure of the excitation frequency from the resonance of the rubidium gas. An error signal derived from the detection of the microwave optical radiation controls the crystal oscillator.

The output of the controlled crystal oscillator then has to be translated from an unmodulated crystal frequency (harmonic of the rubidium's 6,374,625 Hz) into usable frequencies. This requires a

frequency which completely depends on the frequency of the detector's choice of harmonic to which to divide the oscillator output and comes with a natural frequency. An important objective is the synthesis design is to choose a combination of low factors to multiply the divisional ratio and to eliminate the need for over control as used in other rubidium standards.

In the Clauer device, the usual frequency output (4,981,930 Hz) is di-

reduced in four simple steps—a diameter of 6 in., 3 in., 3 in. and 3 in.—to provide a total diameter in a factor of 250. The resulting frequency is mixed with the crystal oscillator output, the resulting difference frequency is filtered out and the same frequency is then up-converted 5000, one of several intended frequency outputs provided by the device.

Other Steps

Several other engineering steps were taken to simplify and compactly package the device. The final output of the receiver is low-noise and frequency-locked for local signals and has a bandwidth which frequently occurs in these devices of the lamp is not properly excited. It uses six design concepts for this difficult task.

The solution frequency, stand-off is the first product of Cluster Technologies, a firm organized last year (I&W Oct. 24, 1966, p. 54) by Cluster Bureau vice president and director of the planned research laboratory of Space Technology Laboratories. Dr. Donald J. Farnell, a senior scientist at Cluster, is responsible for the frequency stand-off development.

Acceleration Foreseen In Avionic Shakeouts

New York—Mimicry, rate of small electronic components will probably increase in the next several years in the industry's growth rate decreases, Glenn W. Hurling, president of Lakewood Electronics, told the New York Society of Security Analysts here recently.

Predicting a drop to about 5% per year by 1975, Hurling said, "At this lower growth rate the industry is going to find it increasingly difficult to absorb and profit. The extremely high cost of research and development and equipment development is adding to this the effects of shifts in the market's relative importance," he continued. "In addition, he said, will result in the appearance of small companies. The LEC president said that the converse, and consequent reworking of the industry of prime Defense Department electronic sources contracts, will be a concern with more short group of large firms able to compete with diverse technology.

Hurling said that the industry can not expect the electronic portion of DOD's budget to expand in the 1970s as it did during the 1960s. Repeating a caution not frequently voiced by other industry spokesmen, Hurling predicted that small and procurement of modern systems, he noted, will costly. The industrial price tag, necessarily results in small total dollar volume.

GENERAL FILTER CENTER

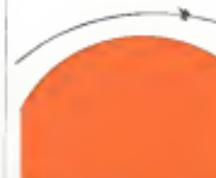
► **Avionics** Circuit by Year's End—Gas constant sources that promises for tracking as well as other radio communications needs will be in the end of the year as still good. Solid Department is studying the future power implications of the proposed "radio monitor" satellite known as Project Oscar (I&W Feb. 13 p. 77), which might be located 2000 miles with a geostationary space site. One reason for the difficulties in operating the plan is that the proposed satellite would be required to monitor a government and a commercial satellite and house both orbits existing roles.

► **Imposed Jamming** Techniques—Reported—Recent psychological experiments show that proper choice of jamming signal can result in as much as 100% in the speech signal to such as disrupt and affect some effective jamming. Dr. Donald W. Smith of Harvard University reported at recent Mid-Atlantic Electronics Conference in Washington. The experiments also showed that effectiveness of an intruder jammer is increased if a high interruption rate is used. Dr. Smith said.

► **Military in Contract Maintenance**—An Army-sponsored study by the Navy Corps of Engineers Defense Contract SAGE direction center to compare effectiveness of military maintenance with private contractor personnel indicates that enlisted personnel are particularly effective as their local military counterparts.

During four years' worth of the ongoing study, the SAGE AN/FPS-10 computer was maintained by International Business Machines Corp. personnel who used ABC methods, performed standard test, repair and maintenance the facilities. Under Contract AF33(65)-1000, maintenance was done by firms 0.125 to 0.175 of total time, and usage time to failure dropped from 12 to 25 hours but since time to repair failure increased from 1.5 hours to 1.7 hours. Investigation report was made in H. W. Adles and A. S. Morris of Mervin and Mihnev Electronics Corporation.

► **New Filter Receiver**—Technology—A new technique for design of ECM filter receiver, which provides continuous monitoring of a broad frequency range and simultaneously reads out the frequency of intercepts with an accuracy of approximately 1% was described by Dr. John L. Grogan of Applied Technology, Inc., at recent Mid-Atlantic Electronics Conference. The tracking accuracy of each a receiver would be approximately ± 70 kHz while covering the entire frequency



HIMBOS



Nimbus is the second step in NASA's research and development program to study weather technology. Different from the predecessor, **Sat**, **Nimbus** will view the Earth at all times.

Sat—Weighing approximately 650 lbs., **Nimbus** will circle the Earth every 108 minutes in a 600-mile high polar orbit.

Equipment—As many as 8 TV cameras, plus infrared measuring devices, tape recorders, telemetry and command instruments will be contained in the satellite.

Data Acquisition—Cloud pictures and other information will be played back on command to 13 meteorologists at Fairbanks, Alaska. Foreign scientists, also, will be invited to participate in the program.

Control and Stabilization—A specially built spring will hold TV cameras always oriented toward the Earth and permit cameras to view particular sectors of the global cloud pattern.

General Electric's Middle and Space Vehicle Department will provide systems integration for **Nimbus**, and will develop the control and stabilization system. M&S is a department of the GE Defense Electronics Division.

GENERAL ELECTRIC

MISSILE AND SPACE VEHICLE INTEGRATION, PHILADELPHIA, PA.

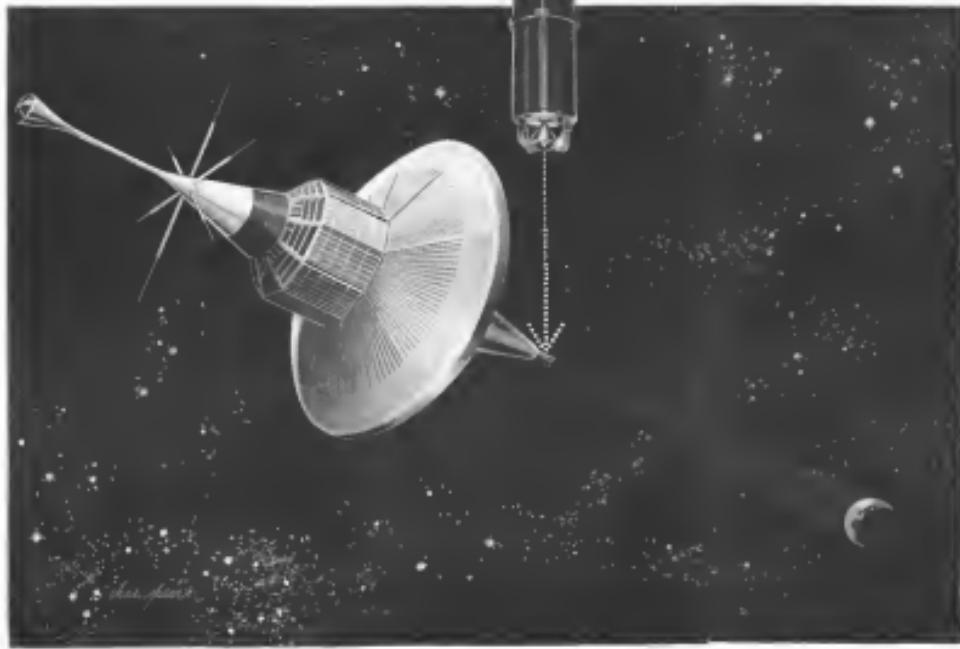
Nimbus will be America's next-generation weather satellite in space. Continually viewing the globe with TV cameras and other sensors, **Nimbus** will help man forecast the weather and learn more about its causes. General Electric's Missile and Space Vehicle Department is constructing the space craft and providing systems integration for the system designed by the National Aeronautics and Space Administration.

GENERAL ELECTRIC



Honeywell's IR Horizon Scanner

"Sees" from 100 to 60,000 miles



IR Detectors Typical Honeywell IR detector and parabolic pyrophones. This POM (pyro) plasma-ignited cell is parabolic in aperture condition, non-cooled, and has a typical response time 1.2 microsec. Honeywell also produces cooled detectors for military and space applications.

Communication Honeywell's MAXMEGIRTM (Medium-Size GEIGER Counter) is a solid-state device for total intelligence via modulation in infrared energy. Rate of light transmission goes secure and can be used for communications, tracking, and target location. Solid-state wave elements and unique design modulate target in MAXMEGIRTM provide fast response range, variable illumination, and



Radiometers Honeywell has recently introduced three infrared radiometers (Optical, Thermal, and Thermal-Optical) for a wide range of applications. These are available from 0.7 to 40 microns.

Intensive research and development on the use of infrared for space exploration instruments gets special emphasis at Honeywell's Los Angeles Optical-Electronics facility.

Attitude sensing for satellites and planet exploration payloads to within 0.1° accuracy is possible with the unique design of the Honeywell LG61A Wide-Angle Horizon Scanner. Models of this infrared scanner meet a wide range of demands for attitude accuracy, life expectancy and range measurement. A scanner with no moving parts, using a semiconductor radiation chopper, is being designed for high reliability and long operational life. Further variation of the basic design provides for operation over the extreme attitude variations required in eccentric orbit missions.

Other infrared programs at Honeywell include the development and production of infrared detectors, surveillance and reconnaissance systems, communications systems, scanners and trackers, in-flight surveillance imaging equipment and IR measurement devices and systems.

For further information on new developments in Optical-Electronics, call your nearest Honeywell representative, or write: Honeywell Aero Division, 1915 Avenue of the Americas, Los Angeles 25, California. *Sale and service offices in all principal areas of the world.*

Honeywell

 *Military Products Group*



WHAT'S SO HOT ABOUT THIS 3 LB. THRUST?

It is a plasma jet, formed at more than 18,000°F and accelerated in a magnetic field to triple its specific impulse. It is being developed in Northrop's Space Propulsion Laboratory as a propulsion system for maneuverable satellite vehicles and spaceships. Its measured 3-pound thrust and high efficiency make it a leading candidate for the first true space drive.

In space, where gravity and friction are forgotten and acceleration time is relatively long, low thrust, high impulse engines like this offer a much more promising approach to space travel than most other

types of propulsion. By looking at this theoretical problem from a solid, engineering point of view, Northrop adds fuel to revolutionary space propulsion.

Northrop's approach to magnetogasdynamics is reflected in almost every phase of space technology. Wherever men, machines and space are coming together, Northrop techniques and experience are helping to find solid, practical answers.

NORAIR
A DIVISION OF
NORTHROP

stage of two to four gigacycles, Genghis and Boreas output could be displayed on a cathode ray tube with a gain displacement of the CRT beam with respect to the polar axis, according to the designer and its analog dispensee representing the amplitude of the intercepted signal. A complete mixer of the new type is expected to weigh 30 lb and occupy about one cubic foot, Genghis said.

► New Multilayer Superconductor Developed — New superconductor material whose cold-worked alloy is resilient and strong enough to be bent into wire, bars and strips without loss of its superconducting properties, has been developed by Microtel International, a division of North American Aviation under sponsorship of the Atomic Energy Commission. New material consists of three parts: niobium in one part, niobium-30% titanium in one part, and niobium-15.3% titanium-15.3% vanadium-1.5% niobium in a third part. The new material has conducted 150,000 amperes per square centimeter in a 10,000-gauss field at liquid helium temperatures and is expected to sustain higher currents in even higher fields.



Polaris Antenna

Retractable whip-type high-frequency radio antenna for Polaris satellites, developed by Hoffman Electronics Corp., was selected for testing in cover operations between 2 and 10 sec, as shown in model above. Lending aid, in the form of John Dosek, part of antenna in that area, is shown. Dosek added to that form the rest of the antenna. Miniature motor can move whip 10 in. past its original position without changing of total extension length of antenna or time for final fast operation. Radio operation is controlled by a solid-state relay and data is being sent to a decoder in model. Endless antenna can be softbowed over a distance of 40 in., Hoffman said. Antenna can also find use in Titan II missile sites.



Let's talk
impulse in
space

Exotic chemical propellants will often find their most useful applications in upper stages, for course or orbit correction and lunar landing or take-off. Isp values compared at $P_0=0.2$ psia have a different relationship than when compared at $P_0=14.7$ psia. Such an approximation of "space" condition gives a much truer picture of the relative performance of propellant systems. We present (from Gentry's new booklet — Propellant Performance Data*) a few excerpts to illustrate the point. As the U.S. standard on LOX-RP, LOX-LH₂ and solids, there is still considerable merit in storable liquid systems for specialized jobs in space.

PROPELLANT SYSTEM	SPECIFIC IMPULSE	
(Sea Level) 1000-14.7	Space 1000-0.2	
H ₂ -D ₂	381	400
H ₂ -D ₂ -O ₂	367	466
EuH ₂ -D ₂	360	460
NH ₃ -H ₂	363	436
NH ₃ -D ₂	327	421
RP-H ₂ O ₂	326	412
RP-H ₂ O ₂	316	405
RP-H ₂ O ₂	306	391
RP-H ₂ O ₂	306	380
RP-D ₂	302	379
RP-D ₂ -O ₂	290	368
NH ₃ -H ₂ O ₂	291	354
CH ₄ -H ₂ O ₂	278	349

*Available upon letterhead request form.

Gallery Chemical Company, Defense Products Department

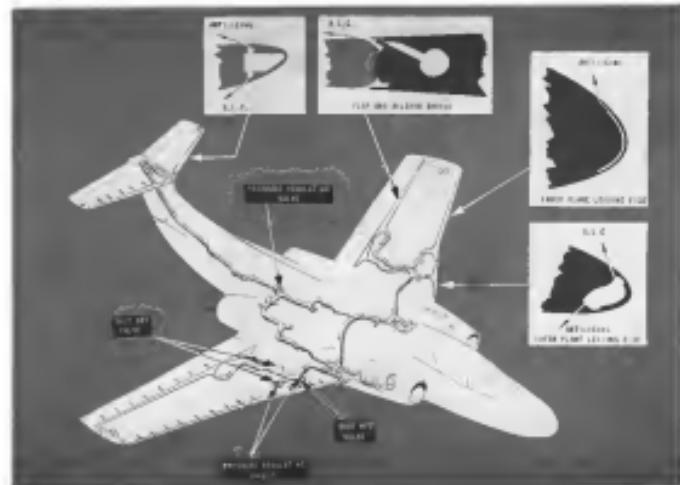
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West Coast: 15007 Lorain Street, Van Nuys, California Telephone: Glendale 5-1570
Midwest: P.O. Box 500, DuPont Circle Building, Telephone: Adams 4-2100
Europe: Office Suite 12, 1000 Avenue, Telephone: Ambassador 4-1161



Second BMEWS Site Soon to Be Operating

Serial USAF *Wing* (Wing) Missile Early Warning Systems site at Clark, USAF, Philippines. Site is in operational status. The system is providing initial radar coverage of the northern parts of the Philippines. A third site is a training complex at Elmendorf, Alaska. Major in Technology, Equipment. Developed, produced and is studied by General Electric (Harris) Mikron Electronics. Developed, manufactured, supplied three radar systems: a fighter and a 300 ft. high, weighing 900 tons, 220 km range of electronic equipment (M-10) and 1500 ft. long bands connecting the scanner buildings (halls). The installation will cover an area of about 3000 sq. kilometers. The system is planned to radar stations that would be provided by the bulk of the attacking BCBM force.

AERONAUTICAL ENGINEERING



GENERAL properties of an integrated switching and broadcast layer control system is shown as measured by Blockwise Address

Combined Anti-Icing, BLC System Tested

By Robert L. Coleman

Luton—High degree of efficiency is claimed by Blackburn Aircraft, Ltd. for an antiicing system which can also be used for boundary layer control for high lift.

New surface relies on heating the surface to be protected by blowing a thin sheet of hot air at sonic speed from a slot on leading edges of protective surface. Slots are located between 15% and 50% of the chord back from the leading edge.

Maximum amount of flood air needed for the system is about 51% of the total flow through the engines. This figure compares with about 12% for the heavier liver system installed on the Blackburn NA.19 naval seaplane.

Describing the system at an existing nitrogenous spreading plant by D. Cooper & Sons Ltd., Blackham eng. Messrs A. G. Smith and C. Jones noted that the supply pressure is such that the slurry is aerodynamically sheared and sprayed out initially at a time that the spreader remains attached to the roadway for a large part of the cloud length.

S. S. Srinivas

Area is obtained from a blood cell pass as the compromise of a turbid zone, and posture should be such as to make possible a closed slit. Smith and Jones contended that this greatly lessens problems of distribution of mass and mass the downstream distance efficient learning, as well as boundary control. Presently subsonic boundary rays in the high temperature and can be used for heating and cooling.

Principle of blowing air for external cooling goes back to 1946 but with substantial improvements of a heat exchanger

The BlackWren system depends on a combination of hot compressed air in sufficient quantities.

One problem in simulating the extremely advective and boundary layers has been sensitivity requirements for the wings with least span and sweepback. At Blackburn, boundary layer simulation has been accomplished by blowing air externally through the wings at 0.016 in. wide, over the leading edges at full span height. Since air can move in the slot at supersonic speeds and remains attached to the surface down to the trailing edge. On the actual aircraft, however, the air blowing is generated by the aircraft's motion, and in the leading edge slot is available to generate boundary layer separation there, leading edge slot is 325 in. long and uses the same air supply as the leading edge. Air from the leading edge is provided first for anti-timing of trailing edge gusts, and second for most conditions of flight.

In addition, Williams has reported some

"FORGING MILITARY SPACEPOWER"

USAF SYSTEMS COMMAND ISSUE

SEPTEMBER 25, 1961



On September 25, AVIATION WEEK and Space Technology will publish one of the most important issues in its history . . . "FORGING MILITARY SPACEPOWER" - USAF SYSTEMS COMMAND ISSUE. For the first time, the complete story of the newly activated USAF Systems Command will be presented to the aerospace industry throughout the world.

The new Systems Command will serve as a single agency to control R&D and procurement of all aircraft, missile, avionics and space systems for the USAF from the idea stage through the time they are in the field ready for use. This concept of a single agency for both systems R&D and systems procurement will have penetrating impact on all aerospace industry companies selling hardware or

research services to the Air Force.

The Systems Command will control approximately \$35 billion in contracts and annually will award \$7.8 billion in new contracts making it the most important single source of aerospace industry business. Further evidence of the impact on industry are policy and procedure changes which can be expected in many areas such as technical approach, contract competition, proposals, cost estimating, management structure and subcontracting.

These are just a few of the important details to be covered in the Systems Command issue, which will constitute a new handbook in doing business with the Air Force. Teams of AVIATION WEEK editors are now visiting the various bases of the Command for full, complete reports. Detailed ob-

servational coverage will be given to procurement, organization, plans and programs, policies, procedures and future technical activities.

AVIATION WEEK is privileged to present this edition to the industry covering our newest and vitally important Command. Prime contractors, subcontractors, suppliers and firms doing R&D work for the Air Force will be extremely interested in this new issue which will lay the groundwork for future contacts with the Command. It will supersede all previous editions on USAF research, development and procurement policies.

Your company is invited to participate by advertising its capabilities and facilities for the furtherance of the defense effort. Write, wire or call collect for space reservations.

Aviation Week
Space Technology

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TODAY'S ECONOMICAL AIR FREIGHTER

ARGOSY

HAWKER SIDDELEY AVIATION 32 Duke Street, St. James's, London SW1

when sensible dies are used, fluid distributors can easily be fitted. Indeed it is feasible to fit the fluid supply tank, lubricant storage, pump, filter, hydraulics and many freighters, which use piston powerplants, cannot obtain enough clearance beneath the engine Case plane, thus rendering the application of fluid systems to higher speed aircraft and helicopters, but Tizard stressed that there are many problems to be solved before any such design system can be considered fully developed.

He remarked that the electric system has been more fully explored than any other, but added that he doubted it could match the fluid system for lightness. TKS has had a helicopter design flying in operation since 1955, is a programme under way and has a considerably lighter form using a Spring Action Twin Fuselage and de Havilland Dove.

Electric drive of helicopter blades has been a major project of Napier. The company initially designed and developed this system with Westland Aircraft for the Westland Wessex. Test program was conducted at Ottawa, Canada, last winter at the main test facility operated by the Canadian Research Council.

R. D. Cook of Napier, and that same name Napier has with a negligible effect on the lift coefficient at normal angles of incidence and while this effect is an airflow drag, lift can be maintained by a steady increase in power.

However, due to blade flexing, vibration and high centrifugal forces, the air does not always pass the blade and self-shedding keeps the helicopter airborne. But Cook warned, self-shedding can cause damage to the tail rotor from chocks of air and she said self-shedding is not remunerative, and air balance vibration can be set up.

Napier's system is designed to shed air in small enough pieces so as not to cause structural damage and to shed it remuneratively.

For the Wessex helicopter, Napier developed keeler main blades and tail with a self-shedding system. These elements, designed for helicopter shedding. On each blade there are six helical sleeves running spirally from one-third root radius to the blade tip. The sleeves are joined at the top and have a single continuous copper return busbar.

Each rotor blade carries a single element on each blade, covering the full span with only a small wrap-around and discolor, axially positioned about the leading edge.

Cook said fatigue tests with spin-ups with ribs attached to blades have shown that the ribs do not detract from fatigue life of light alloy spin-ups and that the ribs fail before any sign of heat rise before

System has an advantage in that parts are prefabricated to be mounted on the blades by the aircraft manufacturer. Many parts have to be developed to a special factor. Main rotor main ribs are protected at the leading edge over the airfoiled surface by a stainless steel shield, fuel against erosion and stress damage. Tests of this fuel was made at speeds up to 600 mph. In Napier and the Royal Aircraft Establishment, Farnborough.

PRODUCTION BRIEFING

General Electric Ordnance Department has a \$176,000 NASA contract for research, development and laboratory study of the Apollo payload system thermal control of the Command Service Module program designed to operate at a temperature of absolute zero. Project has been funded by the Army and Navy for the past two years.

Virginia-Carolina Construction Co. will build a Scott launch vehicle assembly shop at Wallops Island, Va., under a \$391,135 National Aerospace and Space Administration contract.

Martin Orlando Division has received a \$2.25-million Air Force contract to begin production of the nuclear warhead B61B 5 air-to-ground missile.

ALCO, Inc., has a \$259-million AF Contract for management, operation and maintenance of USAF's Advanced Engineering Development Center.

Radio Corp of America has a \$485,000 contract for management, operation and maintenance of three weather satellites for NASA and to provide pre-launch, launch and engineering support for future operations.

Massachusetts Institute of Technology has won a \$400,000 NASA contract for research, development and laboratory study of the Apollo payload system thermal control of the command and control system to be \$4.1 million.

West Germany will build ground system enabling it to participate in National Aerospace and Space Agency's Europa Project. Rete and Brion bound construction satellite was NASA-German agreement at Berlin in earlier year with Great Britain and France.

Boeing, Inc., Seattle, Wash., has developed a ride testing system, RIS 101, for evaluating all modes such as air-to-air, air-to-ground, and ground-to-air modes. For Republic Aviation Corp., flight test installation in the firm's F-105 fighter-bomber.

PROBLEMATICAL RECREATIONS 76



Each of the clowns from Brazil shaped into a nutty path. There were four parts, 25 picarons, 18 engineers, 18 productivity managers, and 32 computers. Although they spent 8 pounds steering, 13 shelling. It was found that 5 picarons spent as much as 4 engineers, that 12 engineers spent as much as 9 productivity managers, and that 6 productivity managers spent as much as 8 computers. How much did each of the four parts spend?

—Circusland

Recent tests, capped by a successful rocket sled run, have proven the capability of the Letton manual navigation system to function in missile environments. The 10-pound P-100 stable platform, heart of the system, remained in alignment during the test. Peak sustained acceleration was an excess of 10 g's. It's yours in the missile guidance market, look into Letton Systems.

ANSWER TO LAST WEEK'S PUZZLE: The test must have been 43,371.800 feet per sec. a sec.

*Current rate of exchange: 1 Pound Sterling = 20 Dollars = \$1.08.

UITTON INDUSTRIES, INC.
Beverly Hills, California

Work better, live
better in the uncongested
Pacific Northwest



After the first flight you were given a "check" and it is now time for another one.

Career openings for
**Tool, Production, Packaging
Engineers**

Being, the world leader in the field of jet line printers, is at work on advanced jet line printers systems of the future. These long range programs offer tool, production and packaging engineers outstanding opportunities to move ahead in their special fields.

TOOL ENGINEERS Assignments involve creation, layout and design of jigs, gages, handling equipment, shop and machine fixtures, and special tools for production of military and commercial jet aircraft. Requirements: a B.S. degree in engineering, preferably mechanical or civil. Experience on aircraft tool design and manufacturing desirable.

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TRANSPORT DIVISION

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Northern N. 150, covered with coarse, well-drained soil, a few feet below bedrock. Forests were scattered and sparse in older sites. Only

Northrop N-156 Operates From Hard Sod Runway



Such reviews tests are performed with the N-156 to prepare for evaluation under similar conditions over routes by Army and USAF officials in air-to-air tactical fighter competitions. This related to 115 ps, as an impact which varied between 0.25 and 0.5 in. in flight. Total weight was 24,000 lb at 12,000 ft gross weight. Slight modification of the flying gear fork was required to accommodate the 22.5 ft total originally designed for the Convair X-10. Test equipment was equipped with two production engines. Standard engines, Northrop officials said, should shorten takeoff roll. Lead author names: Alford, Miller, and, assumed about 45% in the item.





Left: Test-Boiling of large, lightweight solid propellant rocketized UTC Development Center is important phase of multi-million pound thrust booster development program.

SOME OF THE AREAS IN WHICH MAJOR PROGRAMS CURRENTLY ARE BEING CARRIED FORWARD AT UTC

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 A subsidiary of United Aircraft Corporation

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EQUIPMENT

Tri-Axial Airline Seat Limits Acceleration

By David H. Holloman

Washington—New airline transport seats of the type that a sleek airplane is forced to drop to free passengers to protect passengers from impact or death in survivable accidents.

Conceived by Prof. B. R. Lauer and L. M. Potts of Wayne State University in Detroit, the tri-axial acceleration seat uses controlled movement to dampen the peak g forces imposed on a passenger during sudden stops. The revised form is continued to furnish protection on three axes, also would distribute impact forces over a passenger's entire body, including forces on the neck and vital organs from survivable pressures.

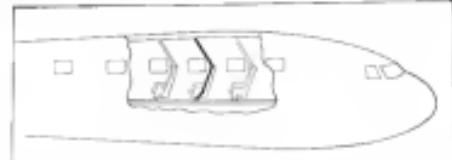
Key feature in the seat's design is that the average acceleration load generated by a typical airline seat—designed to withstand less than 350 mph, impact less than 38 deg.—will not within survivable human tolerance.

A shockingly small number of passengers survive these loads, Lauer and Potts report. "Because they soft pull themselves as they are struck by flying objects, their loads strike adjacent structures as they are pulled."

More of these loads stem from the fact that aircraft acceleration forces are not constant. Thus the passenger is exposed to g forces ranging well above and well below his tolerance in the aircraft itself in a split. The "overexposure" of these forces—whether vertical, longitudinal, lateral or any combination—is the main prime suspect.

Manufacturers' Interest

Neither Wayne State University nor the two professors intend to market the revised seat. An agreement between the two organizations to develop a seat for commercial aircraft manufacturers, however, is option has been received from several airline seat manufacturers, and they too do the testing with their loads if they like the design. According to Prof.



Potts, the seat could be incorporated in new aircraft at "very little extra cost."

Analyzing acceleration experiments conducted by the National Aeronautics and Space Administration, Air Force Col. John Stapp, as author of an acceleration effect, and their own work with the vertical acceleration at Wayne State, Lauer and Potts concluded that these seat should withstand 40 g for 50 milliseconds in the vertical plane, 30 g for 40 milliseconds in the longitudinal plane and 30 g for 40 milliseconds in the lateral plane.

To obtain such resistance, the new seat would:

- Automatically place restraining straps in a more upright position to lessen their acceleration tolerance.
- Seat travel in this instance would be in the direction of aircraft motion than during the g forces imposed on a passenger.

■ Move with respect to the harness as to absorb peak accelerations. Axial absorption of energy through controlled movement of the seat's tri-axial suspension system.

- Consist of a metal shell surrounding and attached to the color coding and attached to the color coding.
- Consist of a metal shell surrounding and attached to the color coding and attached to the color coding.

After controlled deformation, under load, the metal shell of the seat would begin to yield at the threshold of its own acceleration tolerance and con-

tinue to yield throughout the time this tolerance was exercised.

When force is applied to the seat, energy absorbers in the seat suspension—simple extension at catalog devices—would hold accelerations within permissible limits. Vertical acceleration force would be counteracted by the seat's vertical suspension, while longitudinal acceleration force would be absorbed by both ceiling suspension and base attachments.

Mechanical representations of the passengers and motions contained by the seat would place a passenger in a semi-reclining position for comfort. As the passenger's body is forced to move, the metal shell remains in an upright position.

Reclining Mechanism

Reclining acceleration while the seat is inclined probably would be twice or less perpendicular to the longitudinal body axis. "In this situation," according to Lauer and Potts, "the body would tolerate the greatest acceleration and there is no reason to return the passenger to the vertical position." On the other hand, if the acceleration is axially longitudinal only, then the passenger will be returned to the normal seated position by the forces which lead to some loss back in the seat, and the reclining mechanism will be so designed to prevent these forces to return the passenger to the upright position.

The two Wayne State professors also maintain that the use of analog-filter regulators will allow a decrease in seat weight if present safety standards are not met. But if mass acceleration resistance is demanded, ordinary floor suspension will furnish it without additional weight penalties. With an allowance for "loss in other fully tested

Tri-Axial Seat Specifications

Seat Axis	Maximum Passenger Acceleration	Peak Acceleration		Seat Travel to Attain Peak Acceleration
		At the Time of Impact	At the Time Limit	
Vertical	30g	30 g	30 milliseconds	4 in.
Longitudinal	30g	30 g	30 milliseconds	10 in.
Lateral	10g	30 g	30 milliseconds	8 in.

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AEROSPACE CORPORATION



REAR-FACING forward seat has top and bottom suspension points

for uppermost side load," Lutzow and Petrel estimate their test to weight 28 lb.

Technical details of the new seat design, which was developed under a U. S. Public Health Service grant, were disclosed here at a conference called by Federal Aviation Agency to study possible new ways to minimize the possible consequences of acceleration. Calling for a comparative study, results of Board tests remain being sought on airline transports the Air Transport Association expressed doubt that passenger protection is irreversibly safe should be reviewed by reverting present seating arrangements. ATA said:

"There is much evidence from crash investigations to make one wonder if reverting to seat belt seats might provide additional overall protection for the passenger. As a matter of fact, several qualified researchers in this field conclude that forward-facing seat attitudes provide the greatest all-around safety."

Skirtseating Cited

ATA then raised some of the oft-debated seat's possible shortcomings.

"Angular deviation" might force the passenger's head from the seat support and head or backbone the passenger's body might "slide upward" over the seat back if the seat were inclined backward more than 20 to 30 deg at the time of ground impact, the point of an air-bag impact. The center of gravity would impact greater stress on a seat's attachment and tend to rip it from the floor during a crash landing, and the off-facing passenger's head would not be protected from the

ring objects dislodged from fastened baggage checks by the crash's impact, ATA observed.

However, Lutzow and Petrel hold that their seat's contoured shell and self-centering mechanism would limit the chance of a passenger's being dislodged by vertical or "angular" or voluntary accelerations. To the extent that off-facing seats fail at about half the g load capable to forward facing seats, that means that the system is seven percent of standard airline seat.

While such standard seats are reversed, the load during a crash is applied at a higher point on the back,

than would be the case in a forward-facing seat. This results in less range that causes seat failure. By supporting the seat with both top and bottom, the leverage can be minimized.

Passenger Reaction

The objection that passengers in standard facing seats are not protected from flying objects can be eliminated, the designers believe, by using the passenger's downward objects down and limiting the cabin's acceleration. At the same time, infants in seats would be protected by off-facing seats in that they would be forced toward their parent, not shredded away from

STRUCTURAL DYNAMICISTS

Advanced engineering degree preferred.

To evaluate the influence of environmental and complex wave vibrations and shock transmission on structures and components.

Analyze mass and elasticity parameters of systems and evaluate responses characteristics utilizing extensive digital and analog computer facilities. Monitor all test data and develop statistical failure history tests for design and verification.

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Advanced engineering degree preferred.

To insure structural integrity of designs through a combination of analytical and experimental methods.

Analyst in the proposal and development of numerical and analytical models of surviving aircraft structures.

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firm, according to Leeser and Patrek. Discussing the popular airline view point that passengers would share in rating "darkness," Leeser and Patrek said an independently conducted survey of 18,800 Military Air Transport Service passengers riding in flying seats which indicated that only 25% objected to the arrangement. A negative answer to a following airline survey was a "preliminary response that probably would not last after a ride of a few minutes," they contend.

FAA has taken no position on the airline's test question. Pending further study, the agency will consider

those other viewpoints expressed at the conference here.

• Air Line Pilots Assn., dissatisfied with the quality and volume of research on fatigue endurance since 1956, recommended that more research be conducted before allowing tests which required by regulation ALPA also urged that the FAA and the aircraft industry concentrate on the development of a technique that the aircraft industry could use to determine whether fatigue endurance is feasible for the life of a given aircraft's airframe.

• Civil Aviation favored off-timing tests. It also urged FAA to "improve" safety by placing the cost of airframe fatigue tests with contractor testing arrangements.



B-70 Fuel Filter

More fuel filter for the North American B-70. Shown is a standard stainless steel cylinder measuring 35 in high and 14 in in diameter. The unit filters jet fuel to remove particles larger than 74 microns with less than 1 µm pressure drop. Smaller filters at each of the aircraft's General Electric F101 engines will remove particles over 40 microns. Filter is produced by Alcan Filter Metal Inc., a subsidiary of Alcan Corp., Glen Cove, N.Y.

order to those installed in most MATS aircraft.

• Civil Aeronautics Board stated that a proposed design allowing seat could contribute to passenger safety. However, the Board would not recommend any regulation requiring such seats at present.

• Aerospace Industries Assn. urged the off-timing test concept until more conclusive evidence indicates the seats would enhance safety.

• Air Force Institute of Pathology conducted vibration tests without qualitative results.

Automatic Landing Seen for Caravelle

Leut, Inc., and Sud Aviation of France have signed an agreement for the development of a wholly automatic landing system for the Sud Caravelle transport.

J. H. Dowse, vice president and general manager of Leut's International Division said that the primary objective of the agreement was "to...to lower present maximum weather restrictions for aircraft operations...and...provide safe, automatically controlled, fully automatic landing."

Sud's Aeronautics Division, Santa Monica, Calif., is conducting the program, using a B-58 test aircraft which will serve as a testbed for the Caravelle installations.

VSTOL

Aerodynamicist • Engineer with interest in dynamics, vibrations and aerelasticity
• Performance Engineer for evaluation of V/STOL systems...

These positions offer both challenging and reward from interested in analytical and experimental research studies on helicopters and other V/STOL aircraft. Work will be extremely varied and will include preliminary evaluations of novel configurations, as well as long-range research studies on the mechanics of flight at low speeds.

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Since expansion in this program requires that we fill these positions immediately, apply to Mr. W. D. Welsh, Personnel Dept.

All inquiries & applications will receive consideration for a strong initial referral to more senior, more advanced assign-

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ELECTRONIC ENGINEERS & PHYSICISTS

REPUBLIC AVIATION NEWS

NEW RECONNAISSANCE ROLE FOR "ELECTRONIC PLANE"

NEW PRIME CONTRACT AWARDED REPUBLIC CREATES DEMANDING ASSIGNMENTS FOR EE's & PHYSICISTS

The development of a reconnaissance capability for Republic's F-105D marks the first "major step" in an all-weather reconnaissance system with an all-sensor airborne weapon system. The new one, F-105D has already earned the title of "the world's first electronic plane." Because its integrated complex of electronic systems permits it to be almost fully automated, flight control, navigation, target seeking, identification and tracking, fire control for discrete weapons are all automatically controlled.

With the addition of a sophisticated reconnaissance system the F-105D becomes a flying electronic platform. System design and analysis of the new reconnaissance package and its unique ground support system, including new challenges to electronic engineers and physicists. Optimum functioning of the whole electronic complex often unique problems.

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Radars (Front & side looking)

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Antennas, Radios

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Aerospace Ground Support Equipment

Digital Computers

Flight & Fire Control Systems

High Speed Tape Recorders

Optical Systems

Other

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LETTERS

U. S. Sethacks

First, I express my desire that our country will not have unnecessary war risks in the field of aviation and space technology.

During World War II, our fighter planes were supposedly the finest, then it was said the Japanese Army began to develop aircraft. After the war, the Soviet Union began to develop aircraft. Now, the Soviet Union has overtaken us, started by the performance of the Soviet Union's MiG-15, and once again in 1957 by the Soviet Spark 3.

We obviously have no one to blame but ourselves, or shall I say our military. Our military has the greatest responsibility for the development of aircraft in the world. We don't feel that this will affect any single country, but this will affect every country, and give us new challenges that may affect anything that is deeply engraved in, or should I say anything in which there has a personal interest. Our existence is at stake. In September 1945, the German Rocket Society (Dracon) began to develop anything in the industry field. 15 years later.

The military will not ever gain that extra 10% for shooting, because they are up against the top 10% of development, which is the Soviet Union's situation, which they would continue to make more, or a little attempt to prove themselves right or their decision.

A good example of this is the North Korean Vanguards. The Army has an advantage over the Soviet Union's situation, but the fact is the Soviet Union's war spirit is the proper answer, to have the Army put the first American missile in orbit.

Aeronautic Marine
Bethpage, Calif.

Selecting Astronauts

I find Mr. Price's letter (AV, Mar. 20, p. 112) very appealing, but not carry his idea in its entirety. I would like to add that the first astronauts should come from the best qualified of our nation that want to send candidates, and extend the opportunity to receive applicants as well as men!

K. R. DONOVAN
Cancer Research
Ph.D.

Nationalistic Revival

There is a great need for a nationalistic revival in the United States. Many years ago, I believe the greatest nationalistic revival was when we did not want to become a nation with different ideas. The class of gass by the men at the time will strengthen the cause of the men in Wash. again, and large cash and men dedicated to work to the representation of Washington, and working again for the same cause.

I know of no better way to do this than to work with the men in Washington, and large cash and men dedicated to the cause of the men in Wash. again, and large cash and men dedicated to work to the representation of Washington, and working again for the same cause.

I shall be interested in leaving him

as soon as possible when the opinions of his results on the cause related to the magazine's editorial columns. Address letter to the Editor, *Aerospace Week*, 1000 19th Street, N.W., Washington, D.C. 20006. Try to keep letters under 150 words and give a genuine identification. We will print personal correspondence, but names of sources will be withheld on request.

Many other businesses have a flagpole and have many other businesses would be willing to go to the expense of installing one.

Let me assure a number of companies that the last indication that we still have a national spirit and the courage to defend our ideals.

A. B. BROWN
President
Edu-Code Corp.
North Hollywood, Calif.

Global Fighter Flight

Should you or your readers care to come over on the possibility of a solo fighter flight around the world, living time 14 to 18 days?

Tell me, yes, but with another asking that this flight could be made by one or several aircraft, and the question is, who would be the leaders? I think that this should not exclude the T-104 or F-100 from consideration.

Why should we do it? Because it hasn't been done. This flight could well will be a new national project. While we are nearly on the way to the moon, we have not had a solo fighter flight, and I don't know if we are trying to push ahead on all of the areas of flight.

LILIAN D. HOLCOMB
Capt., USAF

P.S.-If you have the details, I have the time.

Airlines Scored

As an ex-traveler of long standing, we I think, a reasonable tolerance for the convenience that we want to provide all transports that you, I, can understand non-planned as far as the convenience of a certain mode of transport, is to consider the available alternatives of travel to prove the fact, and need the better alternative to use.

Pulling Together

Does it seem conceivable that with all the opportunity increases the Russian have demonstrated, including such items as Sputnik I, the Venus flights and the Gemini flight, the memory of this country hasn't been pulled together in effectively reduce the Russian's lead.

Is the Russian old or new to have planes to efficient and a concerned with lessons and plannings that the Russian the Russian the Russian learning been enough behind the nuclear lesson, are already surpassing us, despite the memory of the Russian's lead in the space race.

It's up to every American who works in

itself.

Khodorkovskiy, I, protest. But our grandchildren will be subject to consequences to popular benefit for all of the scoundrels and scoundrels that have ahead of us.

(NAME WITHHELD BY REQUEST)



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HARRY LIPKIN
Resistoflex, Israel

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The stress photos here show why. In an ordinary locknut the load is concentrated on the lower three threads of the nut. This load concentration can accelerate bolt fatigue—and possible failure. But with an ESNA Double/Durability* nut—featuring the revolutionary EQUA-STRESS thread pattern—the stress load is re-distributed over *all* the threads. The reliability of the bolt is safe-



OLD



NEW

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LHEB220T, (220,000 psi)



LH2577T, (180,000 psi)
LH3220T, (220,000 psi)



EBT, (180,000 psi)



LH3489T, (180,000 psi)

